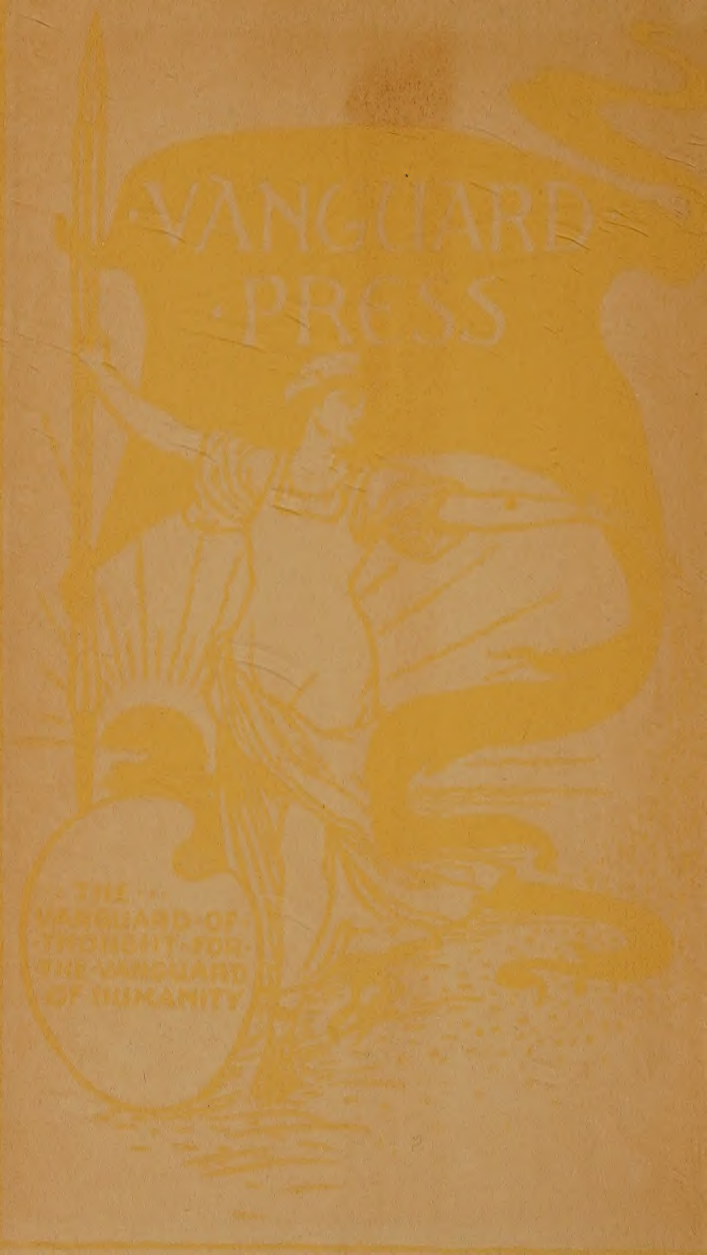
CONFLICT BETWEEN RELIGION AND SCIENCE

JOHN WILLIAM DRAPER

CHARLES T SPRADING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History of

The Conflict

BETWEEN

Religion and Science

By

JOHN WILLIAM DRAPER, M.D., LL.D.

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CHARLES T. SPRADING

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PUBLISHERS' PREFACE

JOHN WILLIAM DRAPER, author of the *History of the Conflict between Religion and Science*, is universally regarded as one of the greatest chemists, physiologists and philosophical writers of modern times. He was born near Liverpool, England, in 1811, educated at a Wesleyan school and at London University, and came to America when he was twenty years old. In 1836 he graduated from the medical school of the University of Pennsylvania, and was appointed Professor of Natural Philosophy, Chemistry and Physiology in Hampden-Sidney College, Virginia. Three years later, he settled in New York City and helped to found the medical school of New York University, in which he was at first Professor of Chemistry, and, after 1850, of Physiology.

Dr. Draper won equal fame as a theoretical and as a practical scientist. His early studies, dealing with radiant energy, phosphorescence, etc., anticipated the wonderful possibilities of spectrum analysis. His skill in the laboratory led to results that were destined to affect the entire life of humanity.

As a photographer, for instance, he used an old building of the New York University for experiments, and improved vastly on the crude methods

of Daguerre. He made the first daguerreotype of the moon; was the first to make microscopic photographs; and took the first pictures of the human face, using his sister and daughter as models. He also participated, with Prof. S. F. B. Morse, in experiments which laid the foundations for the electro-magnetic telegraph.

A complete bibliography of Professor Draper includes nearly a hundred titles. Three of these stand out above the rest. His *History of the Intellectual Development of Europe* (1863) applied the methods of physical science to human history, and aimed to show that "social advancement is as completely under the control of natural law as bodily growth." His *History of the American Civil War* (1870) is especially valuable for the light which it throws on the origin of the war with which Dr. Draper had himself had first-hand contact as an inspector of hospitals. His *History of the Conflict between Religion and Science* (1874) is a Rationalist classic, and will probably never be superseded in its own line.

In the following pages we get the quintessence of this last-named work, which has passed through more than twenty editions in the English language and has been translated into all the important foreign tongues. It helped to inspire Andrew D. White's *History of the Warfare of Science with Theology in Christendom*, published twenty years later. No student of religion can overlook it, and no ecclesiastical apologist has ever been quite com-

fortable in its presence. When the Roman Catholic Church placed it on the Index Expurgatorius, Draper was linked with Galileo, Copernicus, Kepler, Locke, Mill and other thinkers who, in awakening churchly disapproval, gave the best possible evidence of their own intellectual vitality.

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CONFLICT BETWEEN RELIGION AND SCIENCE

CONFLICT OVER ASTRONOMY

An uncritical observation of the aspect of Nature persuades us that the earth is an extended level surface which sustains the dome of the sky, a firmament dividing the waters above from the waters beneath; that the heavenly bodies—the sun, the moon, the stars— pursue their way, moving from east to west, their insignificant size and motion round the motionless earth proclaiming their inferiority. Of the various organic forms surrounding man none rival him in dignity, and hence he seems justified in concluding that every thing has been created for his use—the sun for the purpose of giving him light by day, the moon and stars by night.

Comparative theology shows us that this is the conception of Nature universally adopted in the early phase of intellectual life. It is the belief of all nations in all parts of the world in the beginning of their civilization: geocentric, for it makes the earth the centre of the universe; anthropocentric, for it makes man the central object of the earth. And not only is this the conclusion spontaneously come to from inconsiderate glimpses of the world,

it is also the philosophical basis of various religious revelations, vouchsafed to man from time to time. These revelations, moreover, declare to him that above the crystalline dome of the sky is a region of eternal light and happiness—heaven—the abode of God and the angelic hosts, perhaps also his own abode after death; and beneath the earth a region of eternal darkness and misery, the habitation of those that are evil. In the visible world is thus seen a picture of the invisible.

On the basis of this view of the structure of the world great religious systems have been founded, and hence powerful material interests have been engaged in its support. These have resisted, sometimes by resorting to bloodshed, attempts that have been made to correct its incontestable errors—a resistance grounded on the suspicion that the localization of heaven and hell and the supreme value of man in the universe might be affected.

That such attempts would be made was inevitable. As soon as men began to reason on the subject at all, they could not fail to discredit the assertion that the earth is an indefinite plane. No one can doubt that the sun we see to-day is the self-same sun that we saw yesterday. His reappearance each morning irresistibly suggests that he has passed on the underside of the earth. But this is incompatible with the reign of night in those regions. It presents more or less distinctly the idea of the globular form of the earth.

The earth cannot extend indefinitely downward; for the sun cannot go through it, nor through any

crevice or passage in it, since he rises and sets in different positions at different seasons of the year. The stars also move under it in countless courses. There must, therefore, be a clear way beneath.

To reconcile revelation with these innovating facts, schemes, such as that of Cosmas Indicopleustes in his Christian Topography, were doubtless often adopted. It asserted that in the northern parts of the flat earth there is an immense mountain, behind which the sun passes, and thus produces night.

At a very remote historical period the mechanism of eclipses had been discovered. Those of the moon demonstrated that the shadow of the earth is always circular. The form of the earth must therefore be globular. A body which in all positions casts a circular shadow must itself be spherical. Other considerations, with which every one is now familiar, could not fail to establish that such is her figure.

But the determination of the shape of the earth by no means deposed her from her position of superiority. Apparently vastly larger than all other things, it was fitting that she should be considered not merely as the centre of the world, but, in truth, as—the world. All other objects in their aggregate seemed utterly unimportant in comparison with her.

Though the consequences flowing from an admission of the globular figure of the earth affected very profoundly existing theological ideas, they were of much less moment than those depending on a determination of her size. It needed but an ele-

mentary knowledge of geometry to perceive that correct ideas on this point could be readily obtained by measuring a degree on her surface. Probably there were early attempts to accomplish this object, the results of which have been lost. But Eratosthenes executed one between Syene and Alexandria, in Egypt, Syene being supposed to be exactly under the tropic of Cancer. The two places are, however, not on the same meridian, and the distance between them was estimated, not measured. Two centuries later, Posidonius made another attempt between Alexandria and Rhodes; the bright star Canopus just grazed the horizon at the latter place, at Alexandria it rose $7\frac{1}{2}°$. In this instance, also, since the direction lay across the sea, the distance was estimated, not measured. Finally, the Khalif Al-Mamun made two sets of measures, one on the shore of the Red Sea, the other near Cufa, in Mesopotamia. The general result of these various observations gave for the earth's diameter between seven and eight thousand miles.

This approximate determination of the size of the earth tended to depose her from her dominating position, and gave rise to very serious theological results. In this the ancient investigations of Aristarchus of Samos, one of the Alexandrian school, 280 B. C., powerfully aided. In his treatise on the magnitudes and distances of the sun and moon, he explains the ingenious though imperfect method to which he had resorted for the solution of that problem. Many ages previously a speculation had been brought from India to Europe by Pythagoras. It

presented the sun as the centre of the system. Around him the planets revolved in circular orbits, their order of position being Mercury, Venus, Earth, Mars, Jupiter, Saturn, each of them being supposed to rotate on its axis as it revolved round the sun. According to Cicero, Nicetas suggested that, if it were admitted that the earth revolves on her axis, the difficulty presented by the inconceivable velocity of the heavens would be avoided.

There is reason to believe that the works of Aristarchus, in the Alexandrian Library, were burnt at the time of the fire of Cæsar. The only treatise of his that has come down to us is that above mentioned, on the size and distance of the sun and moon.

Aristarchus adopted the Pythagorean system as representing the actual facts. This was the result of a recognition of the sun's amazing distance, and therefore of his enormous size. The heliocentric system, thus regarding the sun as the central orb, degraded the earth to a very subordinate rank, making her only one of a company of six revolving bodies.

But this is not the only contribution conferred on astronomy by Aristarchus, for, considering that the movement of the earth does not sensibly affect the apparent position of the stars, he inferred that they are incomparably more distant from us than the sun. He, therefore, of all the ancients, as Laplace remarks, had the most correct ideas of the grandeur of the universe. He saw that the earth is of absolutely insignificant size, when compared with the

stellar distances. He saw, too, that there is nothing above us but space and stars.

But the views of Aristarchus, as respects the emplacement of the planetary bodies, were not accepted by antiquity; the system proposed by Ptolemy, and incorporated in his "Syntaxis," was universally preferred. The physical philosophy of those times was very imperfect—one of Ptolemy's objections to the Pythagorean system being that, if the earth were in motion, it would leave the air and other light bodies behind it. He therefore placed the earth in the central position, and in succession revolved round her the Moon, Mercury, Venus, the Sun, Mars, Jupiter, Saturn; beyond the orbit of Saturn came the firmament of the fixed stars. As to the solid crystalline spheres, one moving from east to west, the other from north to south, these were a fancy of Eudoxus, to which Ptolemy does not allude.

The Ptolemaic system is, therefore, essentially a geocentric system. It left the earth in her position of superiority, and hence gave no cause of umbrage to religious opinions, Christian or Mohammedan. The immense reputation of its author, the signal ability of his great work on the mechanism of the heavens, sustained it for almost fourteen hundred years—that is, from the second to the sixteenth century.

In Christendom, the greater part of this long period was consumed in disputes respecting the nature of God, and in struggles for ecclesiastical power. The authority of the Fathers, and the pre-

vailing belief that the Scriptures contain the sum of all knowledge, discouraged any investigation of Nature. If by chance a passing interest was taken in some astronomical question, it was at once settled by a reference to such authorities as the writings of Augustine or Lactantius, not by an appeal to the phenomena of the heavens. So great was the preference given to sacred over profane learning, that Christianity had been in existence fifteen hundred years, and had not produced a single astronomer.

The Mohammedan nations did much better. Their cultivation of science dates from the capture of Alexandria, A. D. 638. This was only six years after the death of the Prophet. In less than two centuries they had not only become acquainted with, but correctly appreciated, the Greek scientific writers. By his treaty with Michael III., the Khalif Al-Mamun had obtained a copy of the "Syntaxis" of Ptolemy. He had it forthwith translated into Arabic. It became at once the great authority of Saracen astronomy. From this basis the Saracens had advanced to the solution of some of the most important scientific problems. They had ascertained the dimensions of the earth; they had registered or catalogued all the stars visible in their heavens, giving to those of the larger magnitudes the names they still bear on our maps and globes; they determined the true length of the year, discovered astronomical refraction, invented the pendulum-clock, improved the photometry of the stars, ascertained the curvilinear path of a ray of light through the air, explained the phenomena of the

horizontal sun and moon, and why we see those bodies before they have risen and after they have set; measured the height of the atmosphere, determining it to be fifty-eight miles; given the true theory of the twilight, and of the twinkling of the stars. They had built the first observatory in Europe. So accurate were they in their observations, that the ablest modern mathematicians have made use of their results. Thus Laplace, in his "Système du Monde," adduces the observations of Al-Batagni as affording incontestable proof of the diminution of the eccentricity of the earth's orbit. He uses those of Ibn-Junis in his discussion of the obliquity of the ecliptic, and also in the case of the problems of the greater inequalities of Jupiter and Saturn.

These represent but a part, and indeed but a small part, of the services rendered by the Arabian astronomers, in the solution of the problem of the nature of the world. Meanwhile, such was the benighted condition of Christendom, such its deplorable ignorance, that it cared nothing about the matter. Its attention was engrossed by image-worship, transubstantiation, the merits of the saints, miracles, shrine-cures.

This indifference continued until the close of the fifteenth century. Even then there was no scientific inducement. The inciting motives were altogether of a different kind. They originated in commercial rivalries, and the question of the shape of the earth was finally settled by three sailors,

Columbus, Da Gama, and, above all, by Ferdinand Magellan.

The trade of Eastern Asia has always been a source of immense wealth to the Western nations who in succession have obtained it. In the middle ages it had centered in Upper Italy. It was conducted along two lines—a northern, by way of the Black and Caspian Seas, and camel-caravans beyond—the headquarters of this were at Genoa; and a southern, through the Syrian and Egyptian ports, and by the Arabian Sea, the headquarters of this being at Venice. The merchants engaged in the latter traffic had also made great gains in the transport service of the Crusade-wars.

The Venetians had managed to maintain amicable relations with the Mohammedan powers of Syria and Egypt; they were permitted to have consulates at Alexandria and Damascus, and, notwithstanding the military commotions of which those countries had been the scene, the trade was still maintained in a comparatively flourishing condition. But the northern or Genoese line had been completely broken up by the irruptions of the Tartars and the Turks, and the military and political disturbances of the countries through which it passed. The Eastern trade of Genoa was not merely in a precarious condition—it was on the brink of destruction.

The circular visible horizon and its dip at sea, the gradual appearance and disappearance of ships in the offing, cannot fail to incline intelligent sailors

to a belief in the globular figure of the earth. The writings of the Mohammedan astronomers and philosophers had given currency to that doctrine throughout Western Europe, but, as might be expected, it was received with disfavor by theologians. When Genoa was thus on the very brink of ruin, it occurred to some of her mariners that, if this view were correct, her affairs might be re-established. A ship sailing through the straits of Gibraltar westward, across the Atlantic, would not fail to reach the East Indies. There were apparently other great advantages. Heavy cargoes might be transported without tedious and expensive land-carriage, and without breaking bulk.

Among the Genoese sailors who entertained these views was Christopher Columbus.

He tells us that his attention was drawn to this subject by the writings of Averroes, but among his friends he numbered Toscanelli, a Florentine, who had turned his attention to astronomy, and had become a strong advocate of the globular form. In Genoa itself Columbus met with but little encouragement. He then spent many years in trying to interest different princes in his proposed attempt. Its irreligious tendency was pointed out by the Spanish ecclesiastics, and condemned by the Council of Salamanca; its orthodoxy was confuted from the Pentateuch, the Psalms, the Prophecies, the Gospels, the Epistles, and the writings of the Fathers—St. Chrysostom, St. Augustine, St. Jerome, St. Gregory, St. Basil, St. Ambrose.

At length, however, encouraged by the Spanish

Queen Isabella, and substantially aided by a wealthy seafaring family, the Pinzons of Palos, some of whom joined him personally, he sailed on August 3, 1492, with three small ships, from Palos, carrying with him a letter from King Ferdinand to the Grand-Khan of Tartary, and also a chart, or map, constructed on the basis of that of Toscanelli. A little before midnight, October 11, 1492, he saw from the forecastle of his ship a moving light at a distance. Two hours subsequently a signal-gun from another of the ships announced that they had descried land. At sunrise Columbus landed in the New World.

On his return to Europe it was universally supposed that he had reached the eastern parts of Asia, and that therefore his voyage had been theoretically successful. Columbus himself died in that belief. But numerous voyages which were soon undertaken made known the general contour of the American coast-line, and the discovery of the Great South Sea by Balboa revealed at length the true facts of the case, and the mistake into which both Toscanelli and Columbus had fallen, that in a voyage to the West the distance from Europe to Asia could not exceed the distance passed over in a voyage from Italy to the Gulf of Guinea—a voyage that Columbus had repeatedly made.

In his first voyage, at nightfall on September 13, 1492, being then two and a half degrees east of Corvo, one of the Azores, Columbus observed that the compass-needles of the ships no longer pointed a little to the east of north, but were varying to the

west. The deviation became more and more marked as the expedition advanced. He was not the first to detect the fact of variation, but he was incontestably the first to discover the line of no variation. On the return-voyage the reverse was observed: the variation westward diminished until the meridian in question was reached, when the needles again pointed due north. Thence, as the coast of Europe was approached, the variation was to the east. Columbus, therefore, came to the conclusion that the line of no variation was a fixed geographical line, or boundary, between the Eastern and Western Hemispheres. In the bull of May, 1493, Pope Alexander VI. accordingly adopted this line as the perpetual boundary between the possessions of Spain and Portugal, in his settlement of the disputes of those nations. Subsequently, however, it was discovered that the line was moving eastward. It coincided with the meridian of London in 1662.

By the papal bull the Portuguese possessions were limited to the east of the line of no variation. Information derived from certain Egyptian Jews had reached that government, that it was possible to sail round the continent of Africa, there being at its extreme south a cape which could be easily doubled. An expedition of three ships under Vasco da Gama set sail, July 9, 1497; it doubled the cape on November 20th, and reached Calicut, on the coast of India, May 19, 1498. Under the bull, this voyage to the East gave to the Portuguese the right to the India trade.

Until the cape was doubled, the course of Da

Gama's ships was in a general manner southward. Very soon, it was noticed that the elevation of the pole-star above the horizon was diminishing, and, soon after the equator was reached, that star had ceased to be visible. Meantime other stars, some of them forming magnificent constellations, had come into view—the stars of the Southern Hemisphere. All this was in conformity to theoretical expectations founded on the admission of the globular form of the earth.

The political consequences that at once ensued placed the Papal Government in a position of great embarrassment. Its traditions and policy forbade it to admit any other than the flat figure of the earth, as revealed in the Scriptures. Concealment of the facts was impossible, sophistry was unavailing. Commercial prosperity now left Venice as well as Genoa. The front of Europe was changed. Maritime power had departed from the Mediterranean countries, and passed to those upon the Atlantic coast.

But the Spanish Government did not submit to the advantage thus gained by its commercial rival without an effort. It listened to the representations of one Ferdinand Magellan, that India and the Spice Islands could be reached by sailing to the west, if only a strait or passage through what had now been recognized as "the American Continent" could be discovered; and, if this should be accomplished, Spain, under the papal bull, would have as good a right to the India trade as Portugal. Under the command of Magellan, an expedition of five ships,

carrying two hundred and thirty-seven men, was dispatched from Seville, August 10, 1519.

Magellan at once struck boldly for the South American coast, hoping to find some cleft or passage through the continent by which he might reach the great South Sea. For seventy days he was becalmed on the line; his sailors were appalled by the apprehension that they had drifted into a region where the winds never blew, and that it was impossible for them to escape. Calms, tempests, mutiny, desertion, could not shake his resolution. After more than a year he discovered the strait which now bears his name, and, as Pigafetti, an Italian, who was with him, relates, he shed tears of joy when he found that it had pleased God at length to bring him where he might grapple with the unknown dangers of the South Sea, "the Great and Pacific Ocean."

Driven by famine to eat scraps of skin and leather with which his rigging was here and there bound, to drink water that had gone putrid, his crew dying of hunger and scurvy, this man, firm in his belief of the globular figure of the earth, steered steadily to the northwest, and for nearly four months never saw inhabited land. He estimated that he had sailed over the Pacific not less than twelve thousand miles. He crossed the equator, saw once more the pole-star, and at length made land—the Ladrones. Here he met with adventurers from Sumatra. Among these islands he was killed, either by the savages or by his own men. His lieutenant, Sebastian d'Elcano, now took command of the ship, directing her course for the Cape of Good Hope, and

encountering frightful hardships. He doubled the cape at last, and then for the fourth time crossed the equator. On September 7, 1522, after a voyage of more than three years, he brought his ship, the San Vittoria, to anchor in the port of St. Lucar, near Seville. She had accomplished the greatest achievement in the history of the human race. She had circumnavigated the earth.

The San Vittoria, sailing westward, had come back to her starting-point. Henceforth the theological doctrine of the flatness of the earth was irretrievably overthrown.

Five years after the completion of the voyage of Magellan, was made the first attempt in Christendom to ascertain the size of the earth. This was by Fernel, a French physician, who, having observed the height of the pole-star at Paris, went thence northward until he came to a place where the height of the pole-star was exactly one degree more than at that city. He measured the distance between the two stations by the number of revolutions of one of the wheels of his carriage, to which a proper indicator had been attached, and came to the conclusion that the earth's circumference is about twenty-four thousand four hundred and eighty Italian miles.

Measures executed more and more carefully were made in many countries: by Snell in Holland; by Norwood between London and York in England; by Picard, under the auspices of the French Academy of Sciences, in France. Picard's plan was to connect two points by a series of triangles, and,

thus ascertaining the length of the arc of a meridian intercepted between them, to compare it with the difference of latitudes found from celestial observations. The stations were Malvoisine in the vicinity of Paris, and Sourdon near Amiens. The difference of latitudes was determined by observing the zenith-distances of δ Cassiopeia. There are two points of interest connected with Picard's operation: it was the first in which instruments furnished with telescopes were employed; and its result, as we shall shortly see, was to Newton the first confirmation of the theory of universal gravitation.

At this time it had become clear from mechanical considerations, more especially such as had been deduced by Newton, that, since the earth is a rotating body, her form cannot be that of a perfect sphere, but must be that of a spheroid, oblate or flattened at the poles. It would follow, from this, that the length of a degree must be greater near the poles than at the equator.

The French Academy resolved to extend Picard's operation, by prolonging the measures in each direction, and making the result the basis of a more accurate map of France. Delays, however, took place, and it was not until 1718 that the measures, from Dunkirk on the north to the southern extremity of France, were completed. A discussion arose as to the interpretation of these measures, some affirming that they indicated a prolate, others an oblate spheroid; the former figure may be popularly represented by a lemon, the latter by an

orange. To settle this, the French Government, aided by the Academy, sent out two expeditions to measure degrees of the meridian—one under the equator, the other as far north as possible; the former went to Peru, the latter to Swedish Lapland. Very great difficulties were encountered by both parties. The Lapland commission, however, completed its observations long before the Peruvian, which consumed not less than nine years. The results of the measures thus obtained confirmed the theoretical expectation of the oblate form. Since that time many extensive and exact repetitions of the observation have been made, among which may be mentioned those of the English in England and in India, and particularly that of the French on the occasion of the introduction of the metric system of weights and measures. It was begun by Delambre and Mechain, from Dunkirk to Barcelona, and thence extended, by Biot and Arago, to the island of Formentera near Minorca. Its length was nearly twelve and a half degrees.

Besides this method of direct measurement, the figure of the earth may be determined from the observed number of oscillations made by a pendulum of invariable length in different latitudes. These, though they confirm the foregoing results, give a somewhat greater ellipticity to the earth than that found by the measurement of degrees. Pendulums vibrate more slowly the nearer they are to the equator. It follows, therefore, that they are there farther from the centre of the earth.

From the most reliable measures that have been made the dimensions of the earth may be thus stated:

Greater or equatorial diameter.....	7,925	miles
Less or polar diameter.....	7,899	"
Difference or polar compression.....	26	"

Such was the result of the discussion respecting the figure and size of the earth. While it was yet undetermined, another controversy arose, fraught with even more serious consequences. This was the conflict respecting the earth's position with regard to the sun and the planetary bodies.

Copernicus, a Prussian, about the year 1507, had completed a book "On the Revolutions of the Heavenly Bodies." He had journeyed to Italy in his youth, had devoted his attention to astronomy, and had taught mathematics at Rome. From a profound study of the Ptolemaic and Pythagorean systems, he had come to a conclusion in favor of the latter, the object of his book being to sustain it. Aware that his doctrines were totally opposed to revealed truth, and foreseeing that they would bring upon him the punishments of the Church, he expressed himself in a cautious and apologetic manner, saying that he had only taken the liberty of trying whether, on the supposition of the earth's motion, it was possible to find better explanations than the ancient ones of the revolutions of the celestial orbs; that in doing this he had only taken the privilege that had been allowed to others, of feign-

ing what hypothesis they chose. The preface was addressed to Pope Paul III.

Full of misgivings as to what might be the result, he refrained from publishing his book for thirty-six years, thinking that "perhaps it might be better to follow the examples of the Pythagoreans and others, who delivered their doctrine only by tradition and to friends." At the entreaty of Cardinal Schomberg he at length published it in 1543. A copy of it was brought to him on his death-bed. Its fate was such as he had anticipated. The Inquisition condemned it as heretical. In their decree, prohibiting it, the Congregation of the Index denounced his system as "that false Pythagorean doctrine utterly contrary to the Holy Scriptures."

Astronomers justly affirm that the book of Copernicus, "De Revolutionibus," changed the face of their science. It incontestably established the heliocentric theory. It showed that the distance of the fixed stars is infinitely great, and that the earth is a mere point in the heavens. Anticipating Newton, Copernicus imputed gravity to the sun, the moon, and heavenly bodies, but he was led astray by assuming that the celestial motions must be circular. Observations on the orbit of Mars, and his different diameters at different times, had led Copernicus to his theory.

In thus denouncing the Copernican system as being in contradiction to revelation, the ecclesiastical authorities were doubtless deeply moved by inferential considerations. To dethrone the earth from her central dominating position, to give her

many equals and not a few superiors, seemed to diminish her claims upon the Divine regard. If each of the countless myriads of stars was a sun, surrounded by revolving globes, peopled with responsible beings like ourselves, if we had fallen so easily and had been redeemed at so stupendous a price as the death of the Son of God, how was it with them? Of them were there none who had fallen or might fall like us? Where, then, for them could a Savior be found?

During the year 1608 one Lippershey, a Hollander, discovered that, by looking through two glass lenses, combined in a certain manner together, distant objects were magnified and rendered very plain. He had invented the telescope. In the following year Galileo, a Florentine, greatly distinguished by his mathematical and scientific writings, hearing of the circumstance, but without knowing the particulars of the construction, invented a form of the instrument for himself. Improving it gradually, he succeeded in making one that could magnify thirty times. Examining the moon, he found that she had valleys like those of the earth, and mountains casting shadows. It had been said in the old times that in the Pleiades there were formerly seven stars, but a legend related that one of them had mysteriously disappeared. On turning his telescope toward them, Galileo found that he could easily count not fewer than forty. In whatever direction he looked, he discovered stars that were totally invisible to the naked eye.

On the night of January 7, 1610, he perceived

three small stars in a straight line, adjacent to the planet Jupiter, and, a few evenings later, a fourth. He found that these were revolving in orbits round the body of the planet, and, with transport, recognized that they presented a miniature representation of the Copernican system.

The announcement of these wonders at once attracted universal attention. The spiritual authorities were not slow to detect their tendency, as endangering the doctrine that the universe was made for man. In the creation of myriads of stars, hitherto invisible, there must surely have been some other motive than that of illuminating the nights for him.

It had been objected to the Copernican theory that, if the planets Mercury and Venus move round the sun in orbits interior to that of the earth, they ought to show phases like those of the moon; and that in the case of Venus, which is so brilliant and conspicuous, these phases should be very obvious. Copernicus himself had admitted the force of the objection, and had vainly tried to find an explanation. Galileo, on turning his telescope to the planet, discovered that the expected phases actually exist; now she was a crescent, then half-moon, then gibbous, then full. Previously to Copernicus, it was supposed that the planets shine by their own light, but the phases of Venus and Mars proved that their light is reflected. The Aristotelian notion, that celestial differ from terrestrial bodies in being incorruptible, received a rude shock from the discoveries of Galileo, that there are mountains and val-

leys in the moon like those of the earth, that the sun is not perfect, but has spots on his face, and that he turns on his axis instead of being in a state of majestic rest. The apparition of new stars had already thrown serious doubts on this theory of incorruptibility.

These and many other beautiful telescopic discoveries tended to the establishment of the truth of the Copernican theory and gave unbounded alarm to the Church. By the low and ignorant ecclesiastics they were denounced as deceptions or frauds. Some affirmed that the telescope might be relied on well enough for terrestrial objects, but with the heavenly bodies it was altogether a different affair. Others declared that its invention was a mere application of Aristotle's remark that stars could be seen in the daytime from the bottom of a deep well. Galileo was accused of imposture, heresy, blasphemy, atheism. With a view of defending himself, he addressed a letter to the Abbe Castelli, suggesting that the Scriptures were never intended to be a scientific authority, but only a moral guide. This made matters worse. He was summoned before the Holy Inquisition, under an accusation of having taught that the earth moves round the sun, a doctrine "utterly contrary to the Scriptures." He was ordered to renounce that heresy, on pain of being imprisoned. He was directed to desist from teaching and advocating the Copernican theory, and pledge himself that he would neither publish nor defend it for the future. Knowing well that Truth has no need of martyrs, he assented to the

required recantation, and gave the promise demanded.

For sixteen years the Church had rest. But in 1632 Galileo ventured on the publication of his work entitled "The System of the World," its object being the vindication of the Copernican doctrine. He was again summoned before the Inquisition at Rome, accused of having asserted that the earth moves round the sun. He was declared to have brought upon himself the penalties of heresy. On his knees, with his hand on the Bible, he was compelled to abjure and curse the doctrine of the movement of the earth. What a spectacle! This venerable man, the most illustrious of his age, forced by the threat of death to deny facts which his judges as well as himself knew to be true! He was then committed to prison, treated with remorseless severity during the remaining ten years of his life, and was denied burial in consecrated ground. Must not that be false which requires for its support so much imposture, so much barbarity? The opinions thus defended by the Inquisition are now objects of derision to the whole civilized world.

One of the greatest of modern mathematicians, referring to this subject, says that the point here contested was one which is for mankind of the highest interest, because of the rank it assigns to the globe that we inhabit. If the earth be immovable in the midst of the universe, man has a right to regard himself as the principal object of the care of Nature. But if the earth be only one of the planets

revolving round the sun, an insignificant body in the solar system, she will disappear entirely in the immensity of the heavens, in which this system, vast as it may appear to us, is nothing but an insensible point.

The triumphant establishment of the Copernican doctrine dates from the invention of the telescope. Soon there was not to be found in all Europe an astronomer who had not accepted the heliocentric theory with its essential postulate, the double motion of the earth—a movement of rotation on her axis, and a movement of revolution round the sun. If additional proof of the latter were needed, it was furnished by Bradley's great discovery of the aberration of the fixed stars, an aberration depending partly on the progressive motion of light, and partly on the revolution of the earth. Bradley's discovery ranked in importance with that of the precession of the equinoxes. Roemer's discovery of the progressive motion of light, though denounced by Fontenelle as a seductive error, and not admitted by Cassini, at length forced its way to universal acceptance.

Next it was necessary to obtain correct ideas of the dimensions of the solar system, or, putting the problem under a more limited form, to determine the distance of the earth from the sun.

In the time of Copernicus it was supposed that the sun's distance could not exceed five million miles, and indeed there were many who thought that estimate very extravagant. From a review of

the observations of Tycho Brahe, Kepler, however, concluded that the error was actually in the opposite direction, and that the estimate must be raised to at least thirteen million. In 1670 Cassini showed that these numbers were altogether inconsistent with the facts, and gave as his conclusion eighty-five million.

The transit of Venus over the face of the sun, June 3, 1769, had been foreseen, and its great value in the solution of this fundamental problem in astronomy appreciated. With commendable alacrity various governments contributed their assistance in making observations, so that in Europe there were fifty stations, in Asia six, in America seventeen. It was for this purpose that the English Government dispatched Captain Cook on his celebrated first voyage. He went to Otaheite. His voyage was crowned with success. The sun rose without a cloud, and the sky continued equally clear throughout the day. The transit at Cook's station lasted from about half-past nine in the morning until about half-past three in the afternoon, and all the observations were made in a satisfactory manner.

But, on the discussion of the observations made at the different stations, it was found that there was not the accordance that could have been desired—the result varying from eighty-eight to one hundred and nine million. The celebrated mathematician, Encke, therefore reviewed them in 1822-'24, and came to the conclusion that the sun's horizontal parallax, that is, the angle under which the semi-diameter of the earth is seen from the sun, is

8 $\frac{576}{1000}$ seconds; this gave as the distance 95,274,000 miles. Subsequently the observations were reconsidered by Hansen, who gave as their result 91,659,000 miles. Still later, Leverrier made it 91,759,000. Airy and Stone, by another method, made it 91,400,000; Stone alone, by a revision of the old observations, 91,730,000; and finally, Foucault and Fizeau, from physical experiments, determining the velocity of light, and therefore in their nature altogether differing from transit observations, 91,400,000.

This distance once determined, the dimensions of the solar system may be ascertained with ease and precision. It is enough to mention that the distance of Neptune from the sun, the most remote of the planets at present known, is about thirty times that of the earth.

By the aid of these numbers we may begin to gain a just appreciation of the doctrine of the human destiny of the universe—the doctrine that all things were made for man. Seen from the sun, the earth dwindles away to a mere speck, a mere dust-mote glistening in his beams. If the reader wishes a more precise valuation, let him hold a page of this book a couple of feet from his eye; then let him consider one of its dots or full-stops; that dot is several hundred times larger in surface than is the earth as seen from the sun!

Of what consequence, then, can such an almost imperceptible particle be? One might think that it could be removed or even annihilated, and yet never be missed. Of what consequence is one of those

human monads, of whom more than a thousand millions swarm on the surface of this all but invisible speck, and of a million of whom scarcely one will leave a trace that he has ever existed? Of what consequence is man, his pleasures or his pains?

Among the arguments brought forward against the Copernican system at the time of its promulgation, was one by the great Danish astronomer, Tycho Brahe, originally urged by Aristarchus against the Pythagorean system, to the effect that, if, as was alleged, the earth moves round the sun, there ought to be a change of the direction in which the fixed stars appear. At one time we are nearer to a particular region of the heavens by a distance equal to the whole diameter of the earth's orbit than we were six months previously, and hence there ought to be a change in the relative position of the stars; they should seem to separate as we approach them, and to close together as we recede from them; or, to use the astronomical expression, these stars should have a yearly parallax.

The parallax of a star is the angle contained between two lines drawn from it—one to the sun, the other to the earth.

At that time, the earth's distance from the sun was greatly under-estimated. Had it been known, as it is now, that that distance exceeds ninety million miles, or that the diameter of the orbit is more than one hundred and eighty million, that argument would doubtless have had very great weight.

In reply to Tycho, it was said that, since the parallax of a body diminishes as its distance increases,

a star may be so far off that its parallax may be imperceptible. This answer proved to be correct. The detection of the parallax of the stars depended on the improvement of instruments for the measurement of angles.

The parallax of α Centauri, a fine double star of the Southern Hemisphere, at present considered to be the nearest of the fixed stars, was first determined by Henderson and Maclear at the Cape of Good Hope in 1832-'33. It is about nine-tenths of a second. Hence this star is almost two hundred and thirty thousand times as far from us as the sun. Seen from it, if the sun were even large enough to fill the whole orbit of the earth, or one hundred and eighty million miles in diameter, he would be a mere point. With its companion, it revolves round their common centre of gravity in eighty-one years, and hence it would seem that their conjoint mass is less than that of the sun.

The star 61 Cygni is of the sixth magnitude. Its parallax was first found by Bessel in 1838, and is about one-third of a second. The distance from us is, therefore, much more than five hundred thousand times that of the sun. With its companion, it revolves round their common centre of gravity in five hundred and twenty years. Their conjoint weight is about one-third that of the sun.

There is reason to believe that the great star Sirius, the brightest in the heavens, is about six times as far off as α Centauri. His probable diameter is twelve million miles, and the light he emits two hundred times more brilliant than that of the

sun. Yet, even through the telescope, he has no measurable diameter; he looks merely like a very bright spark.

The stars, then, differ not merely in visible magnitude, but also in actual size. As the spectroscope shows, they differ greatly in chemical and physical constitution. That instrument is also revealing to us the duration of the life of a star, through changes in the refrangibility of the emitted light. Though, as we have seen, the nearest to us is at an enormous and all but immeasurable distance, this is but the first step—there are others the rays of which have taken thousands, perhaps millions, of years to reach us! The limits of our own system are far beyond the range of our greatest telescopes; what, then, shall we say of other systems beyond? Worlds are scattered like dust in the abysses in space.

Have these gigantic bodies—myriads of which are placed at so vast a distance that our unassisted eyes cannot perceive them—have these no other purpose than that assigned by theologians, to give light to us? Does not their enormous size demonstrate that, as they are centres of force, so they must be centres of motion—suns for other systems of worlds?

While yet these facts were very imperfectly known—indeed, were rather speculations than facts—Giordano Bruno, an Italian, born seven years after the death of Copernicus, published a work on the "Infinity of the Universe and of Worlds;" he was also the author of "Evening Conversations on Ash-Wednesday," an apology for the Copernican

system, and of "The One Sole Cause of Things." To these may be added an allegory published in 1584, "The Expulsion of the Triumphant Beast." He had also collected, for the use of future astronomers, all the observations he could find respecting the new star that suddenly appeared in Cassiopeia, A. D. 1572, and increased in brilliancy, until it surpassed all the other stars. It could be plainly seen in the daytime. On a sudden, November 11th, it was as bright as Venus at her brightest. In the following March it was of the first magnitude. It exhibited various hues of color in a few months, and disappeared in March, 1574.

The star that suddenly appeared in Serpentarius, in Kepler's time (1604), was at first brighter than Venus. It lasted more than a year, and, passing through various tints of purple, yellow, red, became extinguished.

Originally, Bruno was intended for the Church. He had become a Dominican, but was led into doubt by his meditations on the subjects of transubstantiation and the immaculate conception. Not caring to conceal his opinions, he soon fell under the censure of the spiritual authorities, and found it necessary to seek refuge successively in Switzerland, France, England, Germany. The cold-scented sleuth-hounds of the Inquisition followed his track remorselessly, and eventually hunted him back to Italy. He was arrested in Venice, and confined in the Piombi for six years, without books, or paper, or friends.

In England he had given lectures on the plurality

of worlds, and in that country had written, in Italian, his most important works. It added not a little to the exasperation against him, that he was perpetually declaiming against the insincerity, the impostures, of his persecutors—that wherever he went he found skepticism varnished over and concealed by hypocrisy; and that it was not against the belief of men, but against their pretended belief, that he was fighting; that he was struggling with an orthodoxy that had neither morality nor faith.

In his "Evening Conversations" he had insisted that the Scriptures were never intended to teach science, but morals only; and that they cannot be received as of any authority on astronomical and physical subjects. Especially must we reject the view they reveal to us of the constitution of the world, that the earth is a flat surface, supported on pillars; that the sky is a firmament—the floor of heaven. On the contrary, we must believe that the universe is infinite, and that it is filled with self-luminous and opaque worlds, many of them inhabited; that there is nothing above and around us but space and stars. His meditations on these subjects had brought him to the conclusion that the views of Averroes are not far from the truth—that there is an Intellect which animates the universe, and of this Intellect the visible world is only an emanation or manifestation, originated and sustained by force derived from it, and, were that force withdrawn, all things would disappear. This ever-present, all-pervading Intellect is God, who lives in all things, even such as seem not to live; that every thing is

ready to become organized, to burst into life. God is, therefore, "the One Sole Cause of Things," "the All in All."

Bruno may hence be considered among philosophical writers as intermediate between Averroes and Spinoza. The latter held that God and the Universe are the same, that all events happen by an immutable law of Nature, by an unconquerable necessity; that God is the Universe, producing a series of necessary movements or acts, in consequence of intrinsic, unchangeable, and irresistible energy.

On the demand of the spiritual authorities, Bruno was removed from Venice to Rome, and confined in the prison of the Inquisition, accused not only of being a heretic, but also a heresiarch, who had written things unseemly concerning religion; the special charge against him being that he had taught the plurality of worlds, a doctrine repugnant to the whole tenor of Scripture and inimical to revealed religion, especially as regards the plan of salvation. After an imprisonment of two years he was brought before his judges, declared guilty of the acts alleged, excommunicated, and, on his nobly refusing to recant, was delivered over to the secular authorities to be punished "as mercifully as possible, and without the shedding of his blood," the horrible formula for burning a prisoner at the stake. Knowing well that though his tormentors might destroy his body, his thoughts would still live among men, he said to his judges, "Perhaps it is with greater fear that you pass the sentence upon me than I

receive it." The sentence was carried into effect, and he was burnt at Rome, February 16th, A. D. 1600.

No one can recall without sentiments of pity the sufferings of those countless martyrs, who first by one party, and then by another, have been brought for their religious opinion to the stake. But each of these had in his supreme moment a powerful and unfailing support. The passage from this life to the next, though through a hard trial, was the passage from a transient trouble to eternal happiness, an escape from the cruelty of earth to the charity of heaven. On this way through the dark valley the martyr believed that there was an invisible hand that would lead him, a friend that would guide him all the more gently and firmly because of the terrors of the flames. For Bruno there was no such support. The philosophical opinions, for the sake of which he surrendered his life, could give him no consolation. He must fight the last fight alone. Is there not something very grand in the attitude of this solitary man, something which human nature cannot help admiring, as he stands in the gloomy hall before his inexorable judges? No accuser, no witness, no advocate is present, but the familiars of the Holy Office, clad in black, are stealthily moving about. The tormentors and the rack are in the vaults below. He is simply told that he has brought upon himself strong suspicions of heresy, since he has said that there are other worlds than ours. He is asked if he will recant and abjure his error. He cannot and will not deny what he knows to be true,

and perhaps—for he had often done so before—he tells his judges that they, too, in their hearts are of the same belief. What a contrast between this scene of manly honor, of unshaken firmness, of inflexible adherence to the truth, and that other scene which took place more than fifteen centuries previously by the fireside in the hall of Caiaphas the high-priest, when the cock crew, and "the Lord turned and looked upon Peter" (Luke xxii. 61)! And yet it is upon Peter that the Church has grounded her right to act as she did to Bruno.

But perhaps the day approaches when posterity will offer an expiation for this great ecclesiastical crime, and a statue of Bruno be unveiled under the dome of St. Peter's at Rome.

CONTROVERSY OVER GEOLOGY

THE true position of the earth in the universe was established only after long and severe conflict. The Church used whatever power she had, even to the infliction of death, for sustaining her ideas. But it was in vain. The evidence in behalf of the Copernican theory became irresistible. It was at length universally admitted that the sun is the central, the ruling body of our system; the earth only one, and by no means the largest, of a family of encircling planets.

Taught by the issue of that dispute, when the question of the age of the world presented itself for consideration, the Church did not exhibit the active resistance she had displayed on the former occasion. For, though her traditions were again put in jeopardy, they were not, in her judgment, so vitally assailed. To dethrone the Earth from her dominating position was, so the spiritual authorities declared, to undermine the very foundation of revealed truth; but discussions respecting the date of creation might within certain limits be permitted. Those limits were, however, very quickly overpassed, and thus the controversy became as dangerous as the former one had been.

It was not possible to adopt the advice given by Plato in his "Timæus," when treating of this sub-

ject—the origin of the universe: "It is proper that both I who speak and you who judge should remember that we are but men, and therefore, receiving the probable mythological tradition, it is meet that we inquire no further into it." Since the time of St. Augustine the Scriptures had been made the great and final authority in all matters of science, and theologians had deduced from them schemes of chronology and cosmogony which had proved to be stumbling-blocks to the advance of real knowledge.

It is not necessary for us to do more than to allude to some of the leading features of these schemes; their peculiarities will be easily discerned with sufficient clearness. Thus, from the six days of creation and the Sabbath-day of rest, since we are told that a day is with the Lord as a thousand years, it was inferred that the duration of the world will be through six thousand years of suffering, and an additional thousand, a millennium of rest. It was generally admitted that the earth was about four thousand years old at the birth of Christ, but so careless had Europe been in the study of its annals, that not until A. D. 527 had it a proper chronology of its own. A Roman abbot, Dionysius Exiguus, or Dennis the Less, then fixed the vulgar era, and gave Europe its present Christian chronology.

The method followed in obtaining the earliest chronological dates was by computations, mainly founded on the lives of the patriarchs. Much difficulty was encountered in reconciling numerical discrepancies. Even if, as was taken for granted in

those uncritical ages, Moses was the author of the books imputed to him, due weight was not given to the fact that he related events, many of which took place more than two thousand years before he was born. It scarcely seemed necessary to regard the Pentateuch as of plenary inspiration, since no means had been provided to perpetuate its correctness. The different copies which had escaped the chances of time varied very much; thus the Samaritan made thirteen hundred and seven years from the Creation to the Deluge, the Hebrew sixteen hundred and fifty-six, the Septuagint twenty-two hundred and sixty-three. The Septuagint counted fifteen hundred years more from the Creation to Abraham than the Hebrew. In general, however, there was an inclination to the supposition that the Deluge took place about two thousand years after the Creation, and, after another interval of two thousand years, Christ was born. Persons who had given much attention to the subject affirmed that there were not less than one hundred and thirty-two different opinions as to the year in which the Messiah appeared, and hence they declared that it was inexpedient to press for acceptance the Scriptural numbers too closely, since it was plain, from the great differences in different copies, that there had been no providential intervention to perpetuate a correct reading, nor was there any mark by which men could be guided to the only authentic version. Even those held in the highest esteem contained undeniable errors. Thus the Septuagint made Methuselah live until after the Deluge.

It was thought that, in the antediluvian world, the year consisted of three hundred and sixty days. Some even affirmed that this was the origin of the division of the circle into three hundred and sixty degrees. At the time of the Deluge, so many theologians declared, the motion of the sun was altered, and the year became five days and six hours longer. There was a prevalent opinion that that stupendous event occurred on November 2d, in the year of the world 1656. Dr. Whiston, however, disposed to greater precision, inclined to postpone it to November 28th. Some thought that the rainbow was not seen until after the flood; others, apparently with better reason, inferred that it was then first established as a sign. On coming forth from the ark, men received permission to use flesh as food, the antediluvians having been herbivorous! It would seem that the Deluge had not occasioned any great geographical changes, for Noah, relying on his antediluvian knowledge, proceeded to divide the earth among his three sons, giving to Japhet Europe, to Shem Asia, to Ham Africa. No provision was made for America, as he did not know of its existence. These patriarchs, undeterred by the terrible solitudes to which they were going, by the undrained swamps and untracked forests, journeyed to their allotted possessions, and commenced the settlement of the continents.

In seventy years the Asiatic family had increased to several hundred. They had found their way to the plains of Mesopotamia, and there, for some motive that we cannot divine, began building a tower

"whose top might reach to heaven." Eusebius informs us that the work continued for forty years. They did not abandon it until a miraculous confusion of their language took place and dispersed them all over the earth. St. Ambrose shows that this confusion could not have been brought about by men. Origen believes that not even the angels accomplished it.

The confusion of tongues has given rise to many curious speculations among divines as to the primitive speech of man. Some have thought that the language of Adam consisted altogether of nouns, that they were monosyllables, and that the confusion was occasioned by the introduction of polysyllables. But these learned men must surely have overlooked the numerous conversations reported in Genesis, such as those between the Almighty and Adam, the serpent and Eve, etc. In these all the various parts of speech occur. There was, however, a coincidence of opinion that the primitive language was Hebrew. On the general principles of patristicism, it was fitting that this should be the case.

The Greek Fathers computed that, at the time of the dispersion, seventy-two nations were formed, and in this conclusion St. Augustine coincides. But difficulties seem to have been recognized in these computations; thus the learned Dr. Shuckford, who has treated very elaborately on all the foregoing points in his excellent work "On the Sacred and Profane History of the World connected," demonstrates that there could not have been more than

twenty-one or twenty-two men, women, and children, in each of those kingdoms.

A very vital point in this system of chronological computation, based upon the ages of the patriarchs, was the great length of life to which those worthies attained. It was generally supposed that before the Flood "there was a perpetual equinox," and no vicissitudes in Nature. After that event the standard of life diminished one-half, and in the time of the Psalmist it had sunk to seventy years, at which it still remains. Austerities of climate were affirmed to have arisen through the shifting of the earth's axis at the Flood, and to this ill effect were added the noxious influences of that universal catastrophe, which, "converting the surface of the earth into a vast swamp, gave rise to fermentations of the blood and a weakening of the fibres."

With a view of avoiding difficulties arising from the extraordinary length of the patriarchal lives, certain divines suggested that the years spoken of by the sacred penman were not ordinary but lunar years. This, though it might bring the age of those venerable men within the recent term of life, introduced, however, another insuperable difficulty, since it made them have children when only five or six years old.

Sacred science, as interpreted by the Fathers of the Church, demonstrated these facts: 1. That the date of Creation was comparatively recent, not more than four or five thousand years before Christ; 2. That the act of Creation occupied the space of six ordinary days; 3. That the Deluge was

universal, and that the animals which survived it were preserved in an ark; 4. That Adam was created perfect in morality and intelligence, that he fell, and that his descendants have shared in his sin and his fall.

Of these points and others that might be mentioned there were two on which ecclesiastical authority felt that it must insist. These were: 1. The recent date of Creation; for, the remoter that event, the more urgent the necessity of vindicating the justice of God, who apparently had left the majority of our race to its fate, and had reserved salvation for the few who were living in the closing ages of the world; 2. The perfect condition of Adam at his creation, since this was necessary to the theory of the fall, and the plan of salvation.

Theological authorities were therefore constrained to look with disfavor on any attempt to carry back the origin of the earth to an epoch indefinitely remote, and on the Mohammedan theory of the evolution of man from lower forms, or his gradual development to his present condition in the long lapse of time.

From the puerilities, absurdities, and contradictions of the foregoing statement, we may gather how very unsatisfactory this so-called sacred science was. And perhaps we may be brought to the conclusion to which Dr. Shuckford, above quoted, was constrained to come, after his wearisome and unavailing attempt to coördinate its various parts: "As to the Fathers of the first ages of the Church, they

were good men, but not men of universal learning."

Sacred cosmogony regards the formation and modeling of the earth as the direct act of God; it rejects the intervention of secondary causes in those events.

Scientific cosmogony dates from the telescopic discovery made by Cassini—an Italian astronomer, under whose care Louis XIV. placed the Observatory of Paris—that the planet Jupiter is not a sphere, but an oblate spheroid, flattened at the poles. Mechanical philosophy demonstrated that such a figure is the necessary result of the rotation of a yielding mass, and that the more rapid the rotation the greater the flattening, or, what comes to the same thing, the greater the equatorial bulging must be.

From considerations—purely of a mechanical kind—Newton had foreseen that such likewise, though to a less striking extent, must be the figure of the earth. To the protuberant mass is due the precession of the equinoxes, which requires twenty-five thousand eight hundred and sixty-eight years for its completion, and also the nutation of the earth's axis, discovered by Bradley. We have already had occasion to remark that the earth's equatorial diameter exceeds the polar by about twenty-six miles.

Two facts are revealed by the oblateness of the earth: 1. That she has formerly been in a yielding or plastic condition; 2. That she has been modeled by a mechanical and therefore a secondary cause.

But this influence of mechanical causes is mani-

fested not only in the exterior configuration of the globe of the earth as a spheroid of revolution, it also plainly appears on an examination of the arrangement of her substance.

If we consider the aqueous rocks, their aggregate is many miles in thickness; yet they undeniably have been of slow deposit. The material of which they consist has been obtained by the disintegration of ancient lands; it has found its way into the water-courses, and by them been distributed anew. Effects of this kind, taking place before our eyes, require a very considerable lapse of time to produce a well-marked result—a water deposit may in this manner measure in thickness a few inches in a century—what, then, shall we say as to the time consumed in the formation of deposits of many thousand yards?

The position of the coast-line of Egypt has been known for much more than two thousand years. In that time it has made, by reason of the detritus brought down by the Nile, a distinctly-marked encroachment on the Mediterranean. But all Lower Egypt has had a similar origin. The coast-line near the mouth of the Mississippi has been well known for three hundred years, and during that time has scarcely made a perceptible advance on the Gulf of Mexico; but there was a time when the delta of that river was at St. Louis, more than seven hundred miles from its present position. In Egypt and in America—in fact, in all countries—the rivers have been inch by inch prolonging the land into the sea; the slowness of their work and the vastness of its

extent satisfy us that we must concede for the operation enormous periods of time.

To the same conclusion we are brought if we consider the filling of lakes, the deposit of travertines, the denudation of hills, the cutting action of the sea on its shores, the undermining of cliffs, the weathering of rocks by atmospheric water and carbonic acid.

Sedimentary strata must have been originally deposited in planes nearly horizontal. Vast numbers of them have been forced, either by paroxysms at intervals or by gradual movement, into all manner of angular inclinations. Whatever explanations we may offer of these innumerable and immense tilts and fractures, they would seem to demand for their completion an inconceivable length of time.

The coal-bearing strata in Wales, by their gradual submergence, have attained a thickness of 12,000 feet; in Nova Scotia of 14,570 feet. So slow and so steady was this submergence, that erect trees stand one above another on successive levels; seventeen such repetitions may be counted in a thickness of 4,515 feet. The age of the trees is proved by their size, some being four feet in diameter. Round them, as they gradually went down with the subsiding soil, calamites grew, at one level after another. In the Sydney coal-field fifty-nine fossil forests occur in superposition.

Marine shells, found on mountain-tops far in the interior of continents, were regarded by theological writers as an indisputable illustration of the Deluge. But when, as geological studies became more exact,

it was proved that in the crust of the earth vast fresh-water formations are repeatedly intercalated with vast marine ones, like the leaves of a book, it became evident that no single cataclysm was sufficient to account for such results; that the same region, through gradual variations of its level and changes in its topographical surroundings, had sometimes been dry land, sometimes covered with fresh and sometimes with sea water. It became evident also that, for the completion of these changes, tens of thousands of years were required.

To this evidence of a remote origin of the earth, derived from the vast superficial extent, the enormous thickness, and the varied characters of its strata, was added an imposing body of proof depending on its fossil remains. The relative ages of formations having been ascertained, it was shown that there has been an advancing physiological progression of organic forms, both vegetable and animal, from the oldest to the most recent; that those which inhabit the surface in our times are but an insignificant fraction of the prodigious multitude that have inhabited it heretofore; that for each species now living there are thousands that have become extinct. Though special formations are so strikingly characterized by some predominating type of life as to justify such expressions as the age of mollusks, the age of reptiles, the age of mammals, the introduction of the new-comers did not take place abruptly, as by sudden creation. They gradually emerged in an antecedent age, reached their culmination in the one which they characterize, and then gradually

died out in a succeeding. There is no such thing as a sudden creation, a sudden strange appearance—but there is a slow metamorphosis, a slow development from a preëxisting form. Here again we encounter the necessity of admitting for such results long periods of time. Within the range of history no well-marked instance of such development has been witnessed, and we speak with hesitation of doubtful instances of extinction. Yet in geological times myriads of evolutions and extinctions have occurred.

Since thus, within the experience of man, no case of metamorphosis or development has been observed, some have been disposed to deny its possibility altogether, affirming that all the different species have come into existence by separate creative acts. But surely it is less unphilosophical to suppose that each species has been evolved from a predecessor by a modification of its parts, than that it has suddenly started into existence out of nothing. Nor is there much weight in the remark that no man has ever witnessed such a transformation taking place. Let it be remembered that no man has ever witnessed an act of creation, the sudden appearance of an organic form, without any progenitor.

Abrupt, arbitrary, disconnected creative acts may serve to illustrate the Divine power; but that continuous unbroken chain of organisms which extends from palæozoic formations to the formations of recent times, a chain in which each link hangs on a preceding and sustains a succeeding one, demon-

strates to us not only that the production of animated beings is governed by law, but that it is by law that has undergone no change. In its operation, through myriads of ages, there has been no variation, no suspension.

The foregoing paragraphs may serve to indicate the character of a portion of the evidence with which we must deal in considering the problem of the age of the earth. Through the unintermitting labors of geologists, so immense a mass has been accumulated, that many volumes would be required to contain the details. It is drawn from the phenomena presented by all kinds of rocks, aqueous, igneous, metamorphic. Of aqueous rocks it investigates the thickness, the inclined positions, and how they rest unconformably on one another; how those that are of fresh-water origin are intercalated with those that are marine; how vast masses of material have been removed by slow-acting causes of denudation, and extensive geographical surfaces have been remodeled; how continents have undergone movements of elevation and depression, their shores sunk under the ocean, or sea-beaches and sea-cliffs carried far into the interior. It considers the zoological and botanical facts, the fauna and flora of the successive ages, and how in an orderly manner the chain of organic forms, plants, and animals, has been extended, from its dim and doubtful beginnings to our own times. From facts presented by the deposits of coal—coal which, in all its varieties, has originated from the decay of plants—it not only demonstrates the changes that have taken place in

the earth's atmosphere, but also universal changes of climate. From other facts it proves that there have been oscillations of temperature, periods in which the mean heat has risen, and periods in which the polar ices and snows have covered large portions of the existing continents—glacial periods, as they are termed.

One school of geologists, resting its argument on very imposing evidence, teaches that the whole mass of the earth, from being in a molten, or perhaps a vaporous condition, has cooled by radiation in the lapse of millions of ages, until it has reached its present equilibrium of temperature. Astronomical observations give great weight to this interpretation, especially so far as the planetary bodies of the solar system are concerned. It is also supported by such facts as the small mean density of the earth, the increasing temperature at increasing depths, the phenomena of volcanoes and injected veins, and those of igneous and metamorphic rocks. To satisfy the physical changes which this school of geologists contemplates, myriads of centuries are required.

But, with the views that the adoption of the Copernican system has given us, it is plain that we cannot consider the origin and biography of the earth in an isolated way; we must include with her all the other members of the system or family to which she belongs. Nay, more, we cannot restrict ourselves to the solar system; we must embrace in our discussions the starry worlds. And, since we have become familiarized with their almost immeasurable distances from one another, we are prepared to accept

for their origin an immeasurably remote time. There are stars so far off that their light, fast as it travels, has taken thousands of years to reach us, and hence they must have been in existence many thousands of year ago.

Geologists having unanimously agreed—for perhaps there is not a single dissenting voice—that the chronology of the earth must be greatly extended, attempts have been made to give precision to it. Some of these have been based on astronomical, some on physical principles. Thus calculations founded on the known changes of the eccentricity of the earth's orbit, with a view of determining the lapse of time since the beginning of the last glacial period, have given two hundred and forty thousand years. Though the general postulate of the immensity of geological times may be conceded, such calculations are on too uncertain a theoretical basis to furnish incontestable results.

But, considering the whole subject from the present scientific stand-point, it is very clear that the views presented by theological writers, as derived from the Mosaic record, cannot be admitted. Attempts have been repeatedly made to reconcile the revealed with the discovered facts, but they have proved to be unsatisfactory. The Mosaic time is too short, the order of creation incorrect, the divine interventions too anthropomorphic; and, though the presentment of the subject is in harmony with the ideas that men have entertained, when first their minds were turned to the acquisition of natural knowledge, it is not in accordance with their pres-

ent conceptions of the insignificance of the earth and the grandeur of the universe.

Among late geological discoveries is one of special interest; it is the detection of human remains and human works in formations which, though geologically recent, are historically very remote.

The fossil remains of men, with rude implements of rough or chipped flint, of polished stone, of bone, of bronze, are found in Europe in caves, in drifts, in peat-beds. They indicate a savage life, spent in hunting and fishing. Recent researches give reason to believe that, under low and base grades, the existence of man can be traced back into the tertiary times. He was contemporary with the southern elephant, the rhinoceros leptorhinus, the great hippopotamus, perhaps even in the miocene contemporary with the mastodon.

At the close of the Tertiary period, from causes not yet determined, the Northern Hemisphere underwent a great depression of temperature. From a torrid it passed to a glacial condition. After a period of prodigious length, the temperature again rose, and the glaciers that had so extensively covered the surface receded. Once more there was a decline in the heat, and the glaciers again advanced, but this time not so far as formerly. This ushered in the Quaternary period, during which very slowly the temperature came to its present degree. The water deposits that were being made required thousands of centuries for their completion. At the beginning of the Quaternary period there were alive

the cave-bear, the cave-lion, the amphibious hippopotamus, the rhinoceros with chambered nostrils, the mammoth. In fact, the mammoth swarmed. He delighted in a boreal climate. By degrees the reindeer, the horse, the ox, the bison, multiplied, and disputed with him his food. Partly for this reason, and partly because of the increasing heat, he became extinct. From middle Europe, also, the reindeer retired. His departure marks the end of the Quaternary period.

Since the advent of man on the earth, we have, therefore, to deal with periods of incalculable length. Vast changes in the climate and fauna were produced by the slow operation of causes such as are in action at the present day. Figures cannot enable us to appreciate these enormous lapses of time.

It seems to be satisfactorily established, that a race allied to the Basques may be traced back to the Neolithic age. At that time the British Islands were undergoing a change of level, like that at present occurring in the Scandinavian Peninsula. Scotland was rising, England was sinking. In the Pleistocene age there existed in Central Europe a rude race of hunters and fishers closely allied to the Esquimaux.

In the old glacial drift of Scotland the relics of man are found along with those of the fossil elephant. This carries us back to that time above referred to, when a large portion of Europe was covered with ice, which had edged down from the polar regions to southerly latitudes, and, as glaciers,

descended from the summits of the mountain-chains into the plains. Countless species of animals perished in this cataclysm of ice and snow, but man survived.

In his primitive savage condition, living for the most part on fruits, roots, shell-fish, man was in possession of a fact which was certain eventually to insure his civilization. He knew how to make a fire. In peat-beds, under the remains of trees that in those localities have long ago become extinct, his relics are still found, the implements that accompany him indicating a distinct chronological order. Near the surface are those of bronze, lower down those of bone or horn, still lower those of polished stone, and beneath all those of chipped or rough stone. The date of the origin of some of these beds cannot be estimated at less than forty or fifty thousand years.

The caves that have been examined in France and elsewhere have furnished for the Stone age axes, knives, lance and arrow points, scrapers, hammers. The change from what may be termed the chipped to the polished stone period is very gradual. It coincides with the domestication of the dog, an epoch in hunting-life. It embraces thousands of centuries. The appearance of arrow-heads indicates the invention of the bow, and the rise of man from a defensive to an offensive mode of life. The introduction of barbed arrows shows how inventive talent was displaying itself; bone and horn tips, that the huntsman was including smaller animals, and perhaps birds, in his chase; bone whistles, his

companionship with other huntsmen or with his dog. The scraping-knives of flint indicate the use of skin for clothing, and rude bodkins and needles its manufacture. Shells perforated for bracelets and necklaces prove how soon a taste for personal adornment was acquired; the implements necessary for the preparation of pigments suggest the painting of the body, and perhaps tattooing; and bâtons of rank bear witness to the beginning of a social organization.

With the utmost interest we look upon the first germs of art among these primitive men. They have left us rude sketches on pieces of ivory and flakes of bone, and carvings, of the animals contemporary with them. In these prehistoric delineations, sometimes not without spirit, we have mammoths, combats of reindeer. One presents us with a man harpooning a fish, another a hunting-scene of naked men armed with the dart. Man is the only animal who has the propensity of depicting external forms, and of availing himself of the use of fire.

Shell-mounds, consisting of bones and shells, some of which may be justly described as of vast extent, and of a date anterior to the Bronze age, and full of stone implements, bear in all their parts indications of the use of fire. These are often adjacent to the existing coasts; sometimes, however, they are far inland, in certain instances as far as fifty miles. Their contents and position indicate for them a date posterior to that of the great extinct mammals, but prior to the domesticated. Some of these, it is said, cannot be less than one hundred thousand years old.

The lake-dwellings in Switzerland—huts built on piles or logs, wattled with boughs—were, as may be inferred from the accompanying implements, begun in the Stone age, and continued into that of Bronze. In the latter period the evidences become numerous of the adoption of an agricultural life.

It must not be supposed that the periods into which geologists have found it convenient to divide the progress of man in civilization are abrupt epochs, which hold good simultaneously for the whole human race. Thus the wandering Indians of America are only at the present moment emerging from the Stone age. They are still to be seen in many places armed with arrows, tipped with flakes of flint. It is but as yesterday that some have obtained, from the white man, iron, fire-arms, and the horse.

So far as investigations have gone, they indisputably refer the existence of man to a date remote from us by many hundreds of thousands of years. It must be borne in mind that these investigations are quite recent, and confined to a very limited geographical space. No researches have yet been made in those regions which might reasonably be regarded as the primitive habitat of man.

We are thus carried back immeasurably beyond the six thousand years of Patristic chronology. It is difficult to assign a shorter date for the last glaciation of Europe than a quarter of a million of years, and human existence antedates that. But not only is it this grand fact that confronts us, we have to

admit also a primitive animalized state, and a slow, a gradual development.

But this forlorn, this savage condition of humanity is in strong contrast to the paradisiacal happiness of the garden of Eden, and, what is far more serious, it is inconsistent with the theory of the Fall.

I have been induced to place the subject of this chapter out of its proper chronological order, for the sake of presenting what I had to say respecting the nature of the world more completely by itself. The discussions that arose as to the age of the earth were long after the conflict as to the criterion of truth—that is, after the Reformation; indeed, they were substantially included in the present century. They have been conducted with so much moderation as to justify the term I have used in the title of this chapter, "Controversy," rather than "Conflict." Geology has not had to encounter the vindictive opposition with which astronomy was assailed, and, though, on her part, she has insisted on a concession of great antiquity for the earth, she has herself pointed out the unreliability of all numerical estimates thus far offered. The attentive reader of this chapter cannot have failed to observe inconsistencies in the numbers quoted. Though wanting the merit of exactness, those numbers, however, justify the claim of vast antiquity, and draw us to the conclusion that the time-scale of the world answers to the space-scale in magnitude.

CONFLICT OVER TRUTH

"WHAT IS TRUTH?" was the passionate demand of a Roman procurator on one of the most momentous occasions in history. And the Divine Person who stood before him, to whom the interrogation was addressed, made no reply—unless, indeed, silence contained the reply.

Often and vainly had that demand been made before—often and vainly has it been made since. No one has yet given a satisfactory answer.

When, at the dawn of science in Greece, the ancient religion was disappearing like a mist at sunrise, the pious and thoughtful men of that country were thrown into a condition of intellectual despair. Anaxagoras plaintively exclaims, "Nothing can be known, nothing can be learned, nothing can be certain, sense is limited, intellect is weak, life is short." Xenophanes tells us that it is impossible for us to be certain even when we utter the truth. Parmenides declares that the very constitution of man prevents him from ascertaining absolute truth. Empedocles affirms that all philosophical and religious systems must be unreliable, because we have no criterion by which to test them. Democritus asserts that even things that are true cannot impart certainty to us; that the final result of human inquiry is the dis-

covery that man is incapable of absolute knowledge; that, even if the truth be in his possession, he cannot be certain of it. Pyrrho bids us reflect on the necessity of suspending our judgment of things, since we have no criterion of truth; so deep a distrust did he impart to his followers, that they were in the habit of saying, "We assert nothing; no, not even that we assert nothing." Epicurus taught his disciples that truth can never be determined by reason. Arcesilaus, denying both intellectual and sensuous knowledge, publicly avowed that he knew nothing, not even his own ignorance! The general conclusion to which Greek philosophy came was this—that, in view of the contradiction of the evidence of the senses, we cannot distinguish the true from the false; and such is the imperfection of reason, that we cannot affirm the correctness of any philosophical deduction.

It might be supposed that a revelation from God to man would come with such force and clearness as to settle all uncertainties and overwhelm all opposition. A Greek philosopher, less despairing than others, had ventured to affirm that the coexistence of two forms of faith, both claiming to be revealed by the omnipotent God, proves that neither of them is true. But let us remember that it is difficult for men to come to the same conclusion as regards even material and visible things, unless they stand at the same point of view. If discord and distrust were the condition of philosophy three hundred years before the birth of Christ, discord and distrust were the conditon of religion three hundred

years after his death. This is what Hilary, the Bishop of Poictiers, in his well-known passage written about the time of the Nicene Council, says:

"It is a thing equally deplorable and dangerous that there are as many creeds as opinions among men, as many doctrines as inclinations, and as many sources of blasphemy as there are faults among us, because we make creeds arbitrarily and explain them as arbitrarily. Every year, nay, every moon, we make new creeds to describe invisible mysteries; we repent of what we have done; we defend those who repent; we anathematize those whom we defend; we condemn either the doctrines of others in ourselves, or our own in that of others; and, reciprocally tearing each other to pieces, we have been the cause of each other's ruin."

These are not mere words; but the import of this self-accusation can be realized fully only by such as are familiar with the ecclesiastical history of those times. As soon as the first fervor of Christianity as a system of benevolence had declined, dissensions appeared. Ecclesiastical historians assert that "as early as the second century began the contest between faith and reason, religion and philosophy, piety and genius." To compose these dissensions, to obtain some authoritative expression, some criterion of truth, assemblies for consultation were resorted to, which eventually took the form of councils. For a long time they had nothing more than an advisory authority; but, when, in the fourth century, Christianity had attained to imperial rule their dictates became compulsory, being

enforced by the civil power. By this the whole face of the Church was changed. Œcumenical councils—parliaments of Christianity—consisting of delegates from all the churches in the world, were summoned by the authority of the emperor; he presided either personally or nominally in them —composed all differences, and was, in fact, the Pope of Christendom. Mosheim, the historian, to whom I have more particularly referred above, speaking of these times, remarks that "there was nothing to exclude the ignorant from ecclesiastical preferment; the savage and illiterate party, who looked on all kinds of learning, particularly philosophy, as pernicious to piety, was increasing;" and, accordingly, "the disputes carried on in the Council of Nicea offered a remarkable example of the greatest ignorance and utter confusion of ideas, particularly in the language and explanations of those who approved of the decisions of that council." Vast as its influence has been, "the ancient critics are neither agreed concerning the time nor place in which it was assembled, the number of those who sat in it, nor the bishop who presided. No authentic acts of its famous sentence have been committed to writing, or, at least, none have been transmitted to our times." The Church had now become what, in the language of modern politicians, would be called "a confederated republic." The will of the council was determined by a majority vote, and, to secure that, all manner of intrigues and impositions were resorted to; the influence of court females, bribery, and violence, were not

spared. The Council of Nicea had scarcely adjourned, when it was plain to all impartial men that, as a method of establishing a criterion of truth in religious matters, such councils were a total failure. The minority had no rights which the majority need respect. The protest of many good men, that a mere majority vote given by delegates, whose right to vote had never been examined and authorized, could not be received as ascertaining absolute truth, was passed over with contempt, and the consequence was, that council was assembled against council, and their jarring and contradictory decrees spread perplexity and confusion throughout the Christian world. In the fourth century alone there were thirteen councils adverse to Arius, fifteen in his favor, and seventeen for the semi-Arians—in all, forty-five. Minorities were perpetually attempting to use the weapon which majorities had abused.

The impartial ecclesiastical historian above quoted, moreover, says that "two monstrous and calamitous errors were adopted in this fourth century: 1. That it was an act of virtue to deceive and lie when, by that means, the interests of the Church might be promoted. 2. That errors in religion, when maintained and adhered to after proper admonition, were punishable with civil penalties and corporal tortures."

Not without astonishment can we look back at what, in those times, were popularly regarded as criteria of truth. Doctrines were considered as established by the number of martyrs who had pro-

fessed them, by miracles, by the confession of demons, of lunatics, or of persons possessed of evil spirits: thus, St. Ambrose, in his disputes with the Arians, produced men possessed by devils, who, on the approach of the relics of certain martyrs, acknowledged, with loud cries, that the Nicean doctrine of the three persons of the Godhead was true. But the Arians charged him with suborning these infernal witnesses with a weighty bribe. Already, ordeal tribunals were making their appearance. During the following six centuries they were held as a final resort for establishing guilt or innocence, under the forms of trial by cold water, by duel, by the fire, by the cross.

What an utter ignorance of the nature of evidence and its laws have we here! An accused man sinks or swims when thrown into a pond of water; he is burnt or escapes unharmed when he holds a piece of red-hot iron in his hand; a champion whom he has hired is vanquished or vanquishes in single fight; he can keep his arms outstretched like a cross, or fails to do so longer than his accuser, and his innocence or guilt of some imputed crime is established! Are these criteria of truth?

Is it surprising that all Europe was filled with imposture miracles during those ages?—miracles that are a disgrace to the common-sense of man!

But the inevitable day came at length. Assertions and doctrines based upon such preposterous evidence were involved in the discredit that fell upon the evidence itself. As the thirteenth century is approached, we find unbelief in all directions set-

ting in. First, it is plainly seen among the monastic orders, then it spreads rapidly among the common people. Books, such as "The Everlasting Gospel," appear among the former; sects, such as the Catharists, Waldenses, Petrobrussians, arise among the latter. They agreed in this, "that the public and established religion was a motley system of errors and superstitions, and that the dominion which the pope had usurped over Christians was unlawful and tyrannical; that the claim put forth by Rome, that the Bishop of Rome is the supreme lord of the universe, and that neither princes nor bishops, civil governors nor ecclesiastical rulers, have any lawful power in church or state but what they receive from him, is utterly without foundation, and a usurpation of the rights of man."

To withstand this flood of impiety, the papal government established two institutions: 1. The Inquisition; 2. Auricular confession—the latter as a means of detection, the former as a tribunal for punishment.

In general terms, the commission of the Inquisition was, to extirpate religious dissent by terrorism, and surround heresy with the most horrible associations; this necessarily implied the power of determining what constitutes heresy. The criterion of truth was thus in possession of this tribunal, which was charged "to discover and bring to judgment heretics lurking in towns, houses, cellars, woods, caves, and fields." With such savage alacrity did it carry out its object of protecting the interests of religion, that between 1481 and 1808 it had pun-

ished three hundred and forty thousand persons, and of these nearly thirty-two thousand had been burnt! In its earlier days, when public opinion could find no means of protesting against its atrocities, "it often put to death, without appeal, on the very day that they were accused, nobles, clerks, monks, hermits, and lay persons of every rank." In whatever direction thoughtful men looked, the air was full of fearful shadows. No one could indulge in freedom of thought without expecting punishment. So dreadful were the proceedings of the Inquisition, that the exclamation of Pagliarici was the exclamation of thousands: "It is hardly possible for a man to be a Christian, and die in his bed."

The Inquisition destroyed the sectaries of Southern France in the thirteenth century. Its unscrupulous atrocities extirpated Protestantism in Italy and Spain. Nor did it confine itself to religious affairs; it engaged in the suppression of political discontent. Nicolas Eymeric, who was inquisitor-general of the kingdom of Aragon for nearly fifty years, and who died in 1399, has left a frightful statement of its conduct and appalling cruelties in his "Directorium Inquisitorum."

This disgrace of Christianity, and indeed of the human race, had different constitutions in different countries. The papal Inquisition continued the tyranny, and eventually superseded the old episcopal inquisitions. The authority of the bishops was unceremoniously put aside by the officers of the pope.

By the action of the fourth Lateran Council, A. D. 1215, the power of the Inquisition was frightfully increased, the necessity of private confession to a priest—auricular confession—being at that time formally established. This, so far as domestic life was concerned, gave omnipresence and omniscience to the Inquisition. Not a man was safe. In the hands of the priest, who, at the confessional, could extract or extort from them their most secret thoughts, his wife and his servants were turned into spies. Summoned before the dread tribunal, he was simply informed that he lay under strong suspicions of heresy. No accuser was named; but the thumb-screw, the stretching-rope, the boot and wedge, or other enginery of torture, soon supplied that defect, and, innocent or guilty, he accused himself!

Notwithstanding all this power, the Inquisition failed of its purpose. When the heretic could no longer confront it, he evaded it. A dismal disbelief stealthily pervaded all Europe—a denial of Providence, of the immortality of the soul, of human free-will, and that man can possibly resist the absolute necessity, the destiny which envelops him. Ideas such as these were cherished in silence by multitudes of persons driven to them by the tyrannical acts of ecclesiasticism. In spite of persecution, the Waldenses still survived to propagate their declaration that the Roman Church, since Constantine, had degenerated from its purity and sanctity; to protest against the sale of indulgences, which they said had nearly abolished prayer, fasting, alms; to

affirm that it was utterly useless to pray for the souls of the dead, since they must already have gone either to heaven or hell. Though it was generally believed that philosophy or science was pernicious to the interests of Christianity or true piety, the Mohammedan literature then prevailing in Spain was making converts among all classes of society. We see very plainly its influence in many of the sects that then arose; thus, "the Brethren and Sisters of the Free Spirit" held that "the universe came by emanation from God, and would finally return to him by absorption; that rational souls are so many portions of the Supreme Deity; and that the universe, considered as one great whole, is God." These are ideas that can only be entertained in an advanced intellectual condition. Of this sect it is said that many suffered burning with unclouded serenity, with triumphant feelings of cheerfulness and joy. Their orthodox enemies accused them of gratifying their passions at midnight assemblages in darkened rooms, to which both sexes in a condition of nudity repaired. A similar accusation, as is well known, was brought against the primitive Christians by the fashionable society of Rome.

The influences of the Averroistic philosophy were apparent in many of these sects. That Mohammedan system, considered from a Christian point of view, led to the heretical belief that the end of the precepts of Christianity is the union of the soul with the Supreme Being; that God and Nature have the same relations to each other as the soul and the body; that there is but one individual intelligence;

and that one soul performs all the spiritual and rational functions in all the human race. When, subsequently, toward the time of the Reformation, the Italian Averroists were required by the Inquisition to give an account of themselves, they attempted to show that there is a wide distinction between philosophical and religious truth; that things may be philosophically true, and yet theologically false—an exculpatory device condemned at length by the Lateran Council in the time of Leo X.

But, in spite of auricular confession, and the Inquisition, these heretical tendencies survived. It has been truly said that, at the epoch of the Reformation, there lay concealed, in many parts of Europe, persons who entertained the most virulent enmity against Christianity. In this pernicious class were many Aristotelians, such as Pomponatius; many philosophers and wits, such as Bodin, Rabelais, Montaigne; many Italians, as Leo X., Bembo, Bruno.

Miracle-evidence began to fall into discredit during the eleventh and twelfth centuries. The sarcasms of the Hispano-Moorish philosophers had forcibly drawn the attention of many of the more enlightened ecclesiastics to its illusory nature. The discovery of the Pandects of Justinian, at Amalfi, in 1130, doubtless exerted a very powerful influence in promoting the study of Roman jurisprudence, and disseminating better notions as to the character of legal or philosophical evidence. Hallam has cast some doubt on the well-known story of this discovery, but he admits that the celebrated copy in the

Laurentian library, at Florence, is the only one containing the entire fifty books. Twenty years subsequently, the monk Gratian collected together the various papal edicts, the canons of councils, the declarations of the Fathers and Doctors of the Church, in a volume called "The Decretum," considered as the earliest authority in canon law. In the next century Gregory IX. published five books of Decretals, and Boniface VIII. subsequently added a sixth. To these followed the Clementine Constitutions, a seventh book of Decretals, and "A Book of Institutes," published together by Gregory XIII., in 1580, under the title of "Corpus Juris Canonici." The canon law had gradually gained enormous power through the control it had obtained over wills, the guardianship of orphans, marriages, and divorces.

The rejection of miracle-evidence, and the substitution of legal evidence in its stead, accelerated the approach of the Reformation. No longer was it possible to admit the requirement which, in former days, Anselm, the Archbishop of Canterbury, in his treatise, "Cur Deus Homo," had enforced, that we must first believe without examination, and may afterward endeavor to understand what we have thus believed. When Cajetan said to Luther, "Thou must believe that one single drop of Christ's blood is sufficient to redeem the whole human race, and the remaining quantity that was shed in the garden and on the cross was left as a legacy to the pope, to be a treasure from which indulgences were to be drawn," the soul of the

sturdy German monk revolted against such a monstrous assertion, nor would he have believed it though a thousand miracles had been worked in its support. This shameful practice of selling indulgences for the commission of sin originated among the bishops, who, when they had need of money for their private pleasures, obtained it in that way. Abbots and monks, to whom this gainful commerce was denied, raised funds by carrying about relics in solemn procession, and charging a fee for touching them. The popes, in their pecuniary straits, perceiving how lucrative the practice might become, deprived the bishops of the right of making such sales, and appropriated it to themselves, establishing agencies, chiefly among the mendicant orders, for the traffic. Among these orders there was a sharp competition, each boasting of the superior value of its indulgences through its greater influence at the court of heaven, its familiar connection with the Virgin Mary and the saints in glory. Even against Luther himself, who had been an Augustinian monk, a calumny was circulated that he was first alienated from the Church by a traffic of this kind having been conferred on the Dominicans, instead of on his own order, at the time time when Leo X. was raising funds by this means for building St. Peter's, at Rome, A. D. 1517; and there is reason to think that Leo himself, in the earlier stages of the Reformation, attached weight to that allegation.

Indulgences were thus the immediate inciting cause of the Reformation, but very soon there came

into light the real principle that was animating the controversy. It lay in the question, Does the Bible owe its authenticity to the Church? or does the Church owe her authenticity to the Bible? Where is the criterion of truth?

It is not necessary for me here to relate the well-known particulars of that controversy, the desolating wars and scenes of blood to which it gave rise: how Luther posted on the door of the cathedral of Wittemberg ninety-five theses, and was summoned to Rome to answer for his offense; how he appealed from the pope, ill-informed at the time, to the pope when he should have been better instructed; how he was condemned as a heretic, and thereupon appealed to a general council; how, through the disputes about purgatory, transubstantiation, auricular confession, absolution, the fundamental idea which lay at the bottom of the whole movement came into relief, the right of individual judgment; how Luther was now excommunicated, A. D. 1520, and in defiance burnt the bull of excommunication and the volumes of the canon law, which he denounced as aiming at the subversion of all civil government, and the exaltation of the papacy; how by this skillful manœuvre he brought over many of the German princes to his views; how, summoned before the Imperial Diet at Worms, he refused to retract, and, while he was hidden in the castle of Wartburg, his doctrines were spreading, and a reformation under Zwingli broke out in Switzerland; how the principle of sectarian decomposition embedded in the movement gave rise to

rivalries and dissensions between the Germans and the Swiss, and even divided the latter among themselves under the leadership of Zwingli and of Calvin; how the Conference of Marburg, the Diet of Spires, and that at Augsburg, failed to compose the troubles, and eventually the German Reformation assumed a political organization at Smalcalde. The quarrels between the Lutherans and the Calvinists gave hopes to Rome that she might recover her losses.

Leo was not slow to discern that the Lutheran Reformation was something more serious than a squabble among some monks about the profits of indulgence-sales, and the papacy set itself seriously at work to overcome the revolters. It instigated the frightful wars that for so many years desolated Europe, and left animosities which neither the Treaty of Westphalia, nor the Council of Trent after eighteen years of debate, could compose. No one can read without a shudder the attempts that were made to extend the Inquisition in foreign countries. All Europe, Catholic and Protestant, was horror-stricken at the Huguenot massacre of St. Bartholomew's Eve (A. D. 1572). For perfidy and atrocity it has no equal in the annals of the world.

The desperate attempt in which the papacy had been engaged to put down its opponents by instigating civil wars, massacres, and assassinations, proved to be altogether abortive. Nor had the Council of Trent any better result. Ostensibly summoned to correct, illustrate, and fix with perspica-

city the doctrine of the Church, to restore the vigor of its discipline, and to reform the lives of its ministers, it was so manipulated that a large majority of its members were Italians, and under the influence of the pope. Hence the Protestants could not possibly accept its decisions.

The issue of the Reformation was the acceptance by all the Protestant Churches of the dogma that the Bible is a sufficient guide for every Christian man. Tradition was rejected, and the right of private interpretation assured. It was thought that the criterion of truth had at length been obtained.

The authority thus imputed to the Scriptures was not restricted to matters of a purely religious or moral kind; it extended over philosophical facts and to the interpretation of Nature. Many went as far as in the old times Epiphanius had done: he believed that the Bible contained a complete system of mineralogy! The Reformers would tolerate no science that was not in accordance with Genesis. Among them there were many who maintained that religion and piety could never flourish unless separated from learning and science. The fatal maxim that the Bible contained the sum and substance of all knowledge, useful or possible to man—a maxim employed with such pernicious effect of old by Tertullian and by St. Augustine, and which had so often been enforced by papal authority—was still strictly insisted upon. The leaders of the Reformation, Luther and Melanchthon, were determined to banish philosophy from the Church. Luther declared that the study of Aristotle is wholly use-

less; his vilification of that Greek philosopher knew no bounds. He is, says Luther, "truly a devil, a horrid calumniator, a wicked sycophant, a prince of darkness, a real Apollyon, a beast, a most horrid imposter on mankind, one in whom there is scarcely any philosophy, a public and professed liar, a goat, a complete epicure, this twice execrable Aristotle." The schoolmen were, so Luther said, "locusts, caterpillars, frogs, lice." He entertained an abhorrence for them. These opinions, though not so emphatically expressed, were entertained by Calvin. So far as science is concerned, nothing is owed to the Reformation. The Procrustean bed of the Pentateuch was still before her.

In the annals of Christianity the most ill-omened day is that in which she separated herself from science. She compelled Origen, at that time (A. D. 231) its chief representative and supporter in the Church, to abandon his charge in Alexandria, and retire to Cæsarea. In vain through many subsequent centuries did her leading men spend themselves in—as the phrase then went—"drawing forth the internal juice and marrow of the Scriptures for the explaining of things." Universal history from the third to the sixteenth century shows with what result. The dark ages owe their darkness to this fatal policy. Here and there, it is true, there were great men, such as Frederick II. and Alphonso X., who, standing at a very elevated and general point of view, had detected the value of learning to civilization, and, in the midst of the dreary prospect that ecclesiasticism had created

around them, had recognized that science alone can improve the social condition of man.

The infliction of the death-punishment for difference of opinion was still resorted to. When Calvin caused Servetus to be burnt at Geneva, it was obvious to every one that the spirit of persecution was unimpaired. The offense of that philosopher lay in his belief. This was, that the genuine doctrines of Christianity had been lost even before the time of the Council of Nicea; that the Holy Ghost animates the whole system of Nature, like a soul of the world, and that, with the Christ, it will be absorbed, at the end of all things, into the substance of the Deity, from which they had emanated. For this he was roasted to death over a slow fire. Was there any distinction between this Protestant auto-da-fe and the Catholic one of Vanini, who was burnt at Toulouse, by the Inquisition, in 1629, for his "Dialogues concerning Nature"?

The invention of printing, the dissemination of books, had introduced a class of dangers which the persecution of the Inquisition could not reach. In 1559, Pope Paul IV. instituted the Congregation of the Index Expurgatorius. "Its duty is to examine books and manuscripts intended for publication, and to decide whether the people may be permitted to read them; to correct those books of which the errors are not numerous, and which contain certain useful and salutary truths, so as to bring them into harmony with the doctrines of the Church; to condemn those of which the principles are heretical and pernicious; and to grant the peculiar privilege of

perusing heretical books to certain persons. This congregation, which is sometimes held in presence of the pope, but generally in the palace of the Cardinal-president, has a more extensive jurisdiction than that of the Inquisition, as it not only takes cognizance of those books that contain doctrines contrary to the Roman Catholic faith, but of those that concern the duties of morality, the discipline of the Church, the interests of society. Its name is derived from the alphabetical tables or indexes of heretical books and authors composed by its appointment."

The Index Expurgatorius of prohibited books at first indicated those works which it was unlawful to read; but, on this being found insufficient, whatever was not permitted was prohibited—an audacious attempt to prevent all knowledge, except such as suited the purposes of the Church, from reaching the people.

The two rival divisions of the Christian Church —Protestant and Catholic—were thus in accord on one point: to tolerate no science except such as they considered to be agreeable to the Scriptures. The Catholic, being in possession of centralized power, could make its decisions respected wherever its sway was acknowledged, and enforce the monitions of the Index Expurgatorius; the Protestant, whose influence was diffused among many foci in different nations, could not act in such a direct and resolute manner. Its mode of procedure was, by raising a theological odium against an offender, to

put him under a social ban—a course perhaps not less effectual than the other.

As we have seen in former chapters, an antagonism between religion and science had existed from the earliest days of Christianity. On every occasion permitting its display it may be detected through successive centuries. We witness it in the downfall of the Alexandrian Museum, in the cases of Erigena and Wiclif, in the contemptuous rejection by the heretics of the thirteenth century of the Scriptural account of the Creation; but it was not until the epoch of Copernicus, Kepler, and Galileo, that the efforts of Science to burst from the thraldom in which she was fettered became uncontrollable. In all countries the political power of the Church had greatly declined; her leading men perceived that the cloudy foundation on which she had stood was dissolving away. Repressive measures against her antagonists, in old times resorted to with effect, could be no longer advantageously employed. To her interests the burning of a philosopher here and there did more harm than good. In her great conflict with astronomy, a conflict in which Galileo stands as the central figure, she received an utter overthrow; and, as we have seen, when the immortal work of Newton was printed, she could offer no resistance, though Leibnitz affirmed, in the face of Europe, that "Newton had robbed the Deity of some of his most excellent attributes, and had sapped the foundation of natural religion."

From the time of Newton to our own time, the

divergence of science from the dogmas of the Church has continually increased. The Church declared that the earth is the central and most important body in the universe; that the sun and moon and stars are tributary to it. On these points she was worsted by astronomy. She affirmed that a universal deluge had covered the earth; that the only surviving animals were such as had been saved in an ark. In this her error was established by geology. She taught that there was a first man, who, some six or eight thousand years ago, was suddenly created or called into existence in a condition of physical and moral perfection, and from that condition he fell. But anthropology has shown that human beings existed far back in geological time, and in a savage state but little better than that of the brute.

Many good and well-meaning men have attempted to reconcile the statements of Genesis with the discoveries of science, but it is in vain. The divergence has increased so much, that it has become an absolute opposition. One of the antagonists must give way.

May we not, then, be permitted to examine the authenticity of this book, which, since the second century, has been put forth as the criterion of scientific truth? To maintain itself in a position so exalted, it must challenge human criticism.

In the early Christian ages, many of the most eminent Fathers of the Church had serious doubts respecting the authorship of the entire Pentateuch. I have not space, in the limited compass of these

pages, to present in detail the facts and arguments that were then and have since been adduced. The literature of the subject is now very extensive. I may, however, refer the reader to the work of the pious and learned Dean Prideaux, on "The Old and New Testament connected," a work which is one of the literary ornaments of the last century. He will also find the subject more recently and exhaustively discussed by Bishop Colenso. The following paragraphs will convey a sufficiently distinct impression of the present state of the controversy:

The Pentateuch is affirmed to have been written by Moses, under the influence of divine inspiration. Considered thus, as a record vouchsafed and dictated by the Almighty, it commands not only scientific but universal consent.

But here, in the first place, it may be demanded, Who or what is it that has put forth this great claim in its behalf?

Not the work itself. It nowhere claims the authorship of one man, or makes the impious declaration that it is the writing of Almighty God.

Not until after the second century was there any such extravagant demand on human credulity. It originated, not among the higher ranks of Christian philosophers, but among the more fervid Fathers of the Church, whose own writings prove them to have been unlearned and uncritical persons.

Every age, from the second century to our times, has offered men of great ability, both Christian and Jewish, who have altogether repudiated these claims.

Their decision has been founded upon the intrinsic evidence of the books themselves. These furnish plain indications of at least two distinct authors, who have been respectively termed Elohistic and Jehovistic. Hupfeld maintains that the Jehovistic narrative bears marks of having been a second original record, wholly independent of the Elohistic. The two sources from which the narratives have been derived are, in many respects, contradictory of each other. Moreover, it is asserted that the books of the Pentateuch are never ascribed to Moses in the inscriptions of Hebrew manuscripts, or in printed copies of the Hebrew Bible, nor are they styled "Books of Moses" in the Septuagint or Vulgate, but only in modern translations.

It is clear that they cannot be imputed to the sole authorship of Moses, since they record his death. It is clear that they were not written until many hundred years after that event, since they contain references to facts which did not occur until after the establishment of the government of kings among the Jews.

No man may dare to impute them to the inspiration of Almighty God—their inconsistencies, incongruities, contradictions, and impossibilities, as exposed by many learned and pious moderns, both German and English, are so great. It is the decision of these critics that Genesis is a narrative based upon legends; that Exodus is not historically true; that the whole Pentateuch is unhistoric and non-Mosaic; it contains the most extraordinary contradictions and impossibilities, sufficient to in-

volve the credibility of the whole—imperfections so many and so conspicuous that they would destroy the authenticity of any modern historical work.

Hengstenberg, in his "Dissertations on the Genuineness of the Pentateuch," says: "It is the unavoidable fate of a spurious historical work of any length to be involved in contradictions. This must be the case to a very great extent with the Pentateuch, if it be not genuine. If the Pentateuch is spurious, its histories and laws have been fabricated in successive portions, and were committed to writing in the course of many centuries by different individuals. From such a mode of origination, a mass of contradictions is inseparable, and the improving hand of a later editor could never be capable of entirely obliterating them."

To the above conclusions I may add that we are expressly told by Ezra (Esdras ii. 14) that he himself, aided by five other persons, wrote these books in the space of forty days. He says that at the time of the Babylonian captivity the ancient sacred writings of the Jews were burnt, and gives a particular detail of the circumstances under which these were composed. He sets forth that he undertook to write all that had been done in the world since the beginning. It may be said that the books of Esdras are apocryphal, but in return it may be demanded, Has that conclusion been reached on evidence that will withstand modern criticism? In the early ages of Christianity, when the story of the fall of man was not considered as essential to the Christian system, and the doctrine of the atonement had not at-

tained that precision which Anselm eventually gave it, it was very generally admitted by the Fathers of the Church that Ezra probably did so compose the Pentateuch. Thus St. Jerome says, "Sive Mosem dicere volueris auctorem Pentateuchi, sive Esdram ejusdem instauratorem operis, non recuso." Clemens Alexandrinus says that when these books had been destroyed in the captivity of Nebuchadnezzar, Esdras, having become inspired prophetically, reproduced them. Irenæus says the same.

The incidents contained in Genesis, from the first to the tenth chapters inclusive (chapters which, in their bearing upon science, are of more importance than other portions of the Pentateuch), have been obviously compiled from short, fragmentary legends of various authorship. To the critical eye they all, however, present peculiarities which demonstrate that they were written on the banks of the Euphrates, and not in the Desert of Arabia. They contain many Chaldaisms. An Egyptian would not speak of the Mediterranean Sea as being west of him, an Assyrian would. Their scenery and machinery, if such expressions may with propriety be used, are altogether Assyrian, not Egyptian. They were such records as one might expect to meet with in the cuneiform impressions of the tile libraries of the Mesopotamian kings. It is affirmed that one such legend, that of the Deluge, has already been exhumed, and it is not beyond the bounds of probability that the remainder may in like manner be obtained.

From such Assyrian sources, the legends of the creation of the earth and heaven, the garden of Eden, the making of man from clay, and of woman from one of his ribs, the temptation by the serpent, the naming of animals, the cherubim and flaming sword, the Deluge and the ark, the drying up of the waters by the wind, the building of the Tower of Babel, and the confusion of tongues, were obtained by Ezra. He commences abruptly the proper history of the Jews in the eleventh chapter. At that point his universal history ceases; he occupies himself with the story of one family, the descendants of Shem.

It is of this restriction that the Duke of Argyll, in his book on "Primeval Man," very graphically says: "In the genealogy of the family of Shem we have a list of names which are names, and nothing more to us. It is a genealogy which neither does, nor pretends to do, more than to trace the order of succession among a few families only, out of the millions then already existing in the world. Nothing but this order of succession is given, nor is it at all certain that this order is consecutive or complete. Nothing is told us of all that lay behind that curtain of thick darkness, in front of which these names are made to pass; and yet there are, as it were, momentary liftings, through which we have glimpses of great movements which were going on, and had been long going on beyond. No shapes are distinctly seen. Even the direction of those movements can only be guessed. But voices are heard which are as the voices of many waters." I agree

in the opinion of Hupfeld, that "the discovery that the Pentateuch is put together out of various sources, or original documents, is beyond all doubt not only one of the most important and most pregnant with consequences for the interpretation of the historical books of the Old Testament, or rather for the whole of theology and history, but it is also one of the most certain discoveries which have been made in the domain of criticism and the history of literature. Whatever the anticritical party may bring forward to the contrary, it will maintain itself, and not retrograde again through any thing, so long as there exists such a thing as criticism; and it will not be easy for a reader upon the stage of culture on which we stand in the present day, if he goes to the examination unprejudiced, and with an uncorrupted power of appreciating the truth, to be able to ward off its influence."

What then? shall we give up these books? Does not the admission that the narrative of the fall in Eden is legendary carry with it the surrender of that most solemn and sacred of Christian doctrines, the atonement?

Let us reflect on this! Christianity, in its earliest days, when it was converting and conquering the world, knew little or nothing about that doctrine. We have seen that, in his "Apology," Tertullian did not think it worth his while to mention it. It originated among the Gnostic heretics. It was not admitted by the Alexandrian theological school. It was never prominently advanced by the Fathers.

It was not brought into its present commanding position until the time of Anselm. Philo Judæus speaks of the story of the fall as symbolical; Origen regarded it as an allegory. Perhaps some of the Protestant churches may, with reason, be accused of inconsistency, since in part they consider it as mythical, in part real. But, if, with them, we admit that the serpent is symbolical of Satan, does not that cast an air of allegory over the whole narrative?

It is to be regretted that the Christian Church has burdened itself with the defense of these books, and voluntarily made itself answerable for their manifest contradictions and errors. Their vindication, if it were possible, should have been resigned to the Jews, among whom they originated, and by whom they have been transmitted to us. Still more, it is to be deeply regretted that the Pentateuch, a production so imperfect as to be unable to stand the touch of modern criticism, should be put forth as the arbiter of science. Let it be remembered that the exposure of the true character of these books has been made, not by captious enemies, but by pious and learned churchmen, some of them of the highest dignity.

While thus the Protestant churches have insisted on the acknowledgment of the Scriptures as the criterion of truth, the Catholic has, in our own times, declared the infallibility of the pope. It may be said that this infallibility applies only to moral or religious things; but where shall the line of separation be drawn? Omniscience cannot be limited to

a restricted group of questions; in its very nature it implies the knowledge of all, and infallibility means omniscience.

Doubtless, if the fundamental principles of Italian Christianity be admitted, their logical issue is an infallible pope. There is no need to dwell on the unphilosophical nature of this conception; it is destroyed by an examination of the political history of the papacy, and the biography of the popes. The former exhibits all the errors and mistakes to which institutions of a confessedly human character have been found liable; the latter is only too frequently a story of sin and shame.

It was not possible that the authoritative promulgation of the dogma of papal infallibility should meet among enlightened Catholics universal acceptance. Serious and wide-spread dissent has been produced. A doctrine so revolting to common-sense could not find any other result. There are many who affirm that, if infallibility exists anywhere, it is in œcumenical councils, and yet such councils have not always agreed with each other. There are also many who remember that councils have deposed popes, and have passed judgment on their clamors and contentions. Not without reason do Protestants demand, What proof can be given that infallibility exists in the Church at all? what proof is there that the Church has ever been fairly or justly represented in any council? and why should the truth be ascertained by the vote of a majority rather than by that of a minority? How often it has happened that one man, standing at the right

point of view, has descried the truth, and, after having been denounced and persecuted by all others, they have eventually been constrained to adopt his declarations! Of many great discoveries, has not this been the history?

It is not for Science to compose these contesting claims; it is not for her to determine whether the criterion of truth for the religious man shall be found in the Bible, or in the œcumenical council, or in the pope. She only asks the right, which she so willingly accords to others, of adopting a criterion of her own. If she regards unhistorical legends with disdain; if she considers the vote of a majority in the ascertainment of truth with supreme indifference; if she leaves the claim of infallibility in any human being to be vindicated by the stern logic of coming events — the cold impassiveness which in these matters she maintains is what she displays toward her own doctrines. Without hesitation she would give up the theories of gravitation or undulations, if she found that they were irreconcilable with facts. For her the volume of inspiration is the book of Nature, of which the open scroll is ever spread forth before the eyes of every man. Confronting all, it needs no societies for its dissemination. Infinite in extent, eternal in duration, human ambition and human fanaticism have never been able to tamper with it. On the earth it is illustrated by all that is magnificent and beautiful, on the heavens its letters are suns and worlds.

CONFLICT OVER THE GOVERNMENT OF THE UNIVERSE

Two interpretations may be given of the mode of government of the world. It may be by incessant divine interventions, or by the operation of unvarying law.

To the adoption of the former a priesthood will always incline, since it must desire to be considered as standing between the prayer of the votary and the providential act. Its importance is magnified by the power it claims of determining what that act shall be. In the pre-Christian (Roman) religion, the grand office of the priesthood was the discovery of future events by oracles, omens, or an inspection of the entrails of animals, and by the offering of sacrifices to propitiate the gods. In the later, the Christian times, a higher power was claimed; the clergy asserting that, by their intercessions, they could regulate the course of affairs, avert dangers, secure benefits, work miracles, and even change the order of Nature.

Not without reason, therefore, did they look upon the doctrine of government by unvarying law with disfavor. It seemed to depreciate their dignity, to lessen their importance. To them there was something shocking in a God who cannot be swayed by human entreaty, a cold, passionless di-

vinity—something frightful in fatalism, destiny.

But the orderly movement of the heavens could not fail in all ages to make a deep impression on thoughtful observers—the rising and setting of the sun; the increasing or diminishing light of the day; the waxing and waning of the moon; the return of the seasons in their proper courses; the measured march of the wandering planets in the sky—what are all these, and a thousand such, but manifestations of an orderly and unchanging procession of events? The faith of early observers in this interpretation may perhaps have been shaken by the occurrence of such a phenomenon as an eclipse, a sudden and mysterious breach of the ordinary course of natural events; but it would be resumed in tenfold strength as soon as the discovery was made that eclipses themselves recur, and may be predicted.

Astronomical predictions of all kinds depend upon the admission of this fact—that there never has been and never will be any intervention in the operation of natural laws. The scientific philosopher affirms that the condition of the world at any given moment is the direct result of its condition in the preceding moment, and the direct cause of its condition in the subsequent moment. Law and chance are only different names for mechanical necessity.

About fifty years after the death of Copernicus, John Kepler, a native of Würtemberg, who had adopted the heliocentric theory, and who was deeply impressed with the belief that relationships

exist in the revolutions of the planetary bodies round the sun, and that these if correctly examined would reveal the laws under which those movements take place, devoted himself to the study of the distances, times, and velocities of the planets, and the form of their orbits. His method was, to submit the observations to which he had access, such as those of Tycho Brahe, to computations based first on one and then on another hypothesis, rejecting the hypothesis if he found that the calculations did not accord with the observations. The incredible labor he had undergone (he says, "I considered, and I computed, until I almost went mad") was at length rewarded, and in 1609 he published his book, "On the Motions of the Planet Mars." In this he had attempted to reconcile the movements of that planet to the hypothesis of eccentrics and epicycles, but eventually discovered that the orbit of a planet is not a circle but an ellipse, the sun being in one of the foci, and that the areas swept over by a line drawn from the planet to the sun are proportional to the times. These constitute what are now known as the first and second laws of Kepler. Eight years subsequently, he was rewarded by the discovery of a third law, defining the relation between the mean distances of the planets from the sun and the times of their revolutions; "the squares of the periodic times are proportional to the cubes of the distances." In "An Epitome of the Copernican System," published in 1618, he announced this law, and showed that it holds good for the satellites of Jupiter as regards their primary.

Hence it was inferred that the laws which preside over the grand movements of the solar system preside also over the less movements of its constituent parts.

The conception of law which is unmistakably conveyed by Kepler's discoveries, and the evidence they gave in support of the heliocentric as against the geocentric theory, could not fail to incur the reprehension of the Roman authorities. The congregation of the Index, therefore, when they denounced the Copernican system as utterly contrary to the Holy Scriptures, prohibited Kepler's "Epitome" of that system. It was on this occasion that Kepler submitted his celebrated remonstrance: "Eighty years have elapsed during which the doctrines of Copernicus regarding the movement of the earth and the immobility of the sun have been promulgated without hindrance, because it was deemed allowable to dispute concerning natural things, and to elucidate the works of God, and now that new testimony is discovered in proof of the truth of those doctrines—testimony which was not known to the spiritual judges—ye would prohibit the promulgation of the true system of the structure of the universe."

None of Kepler's contemporaries believed the law of the areas, nor was it accepted until the publication of the "Principia" of Newton. In fact, no one in those times understood the philosophical meaning of Kepler's laws. He himself did not foresee what they must inevitably lead to. His mistakes showed how far he was from perceiving their result. Thus

he thought that each planet is the seat of an intelligent principle, and that there is a relation between the magnitudes of the orbits of the five principal planets and the five regular solids of geometry. At first he inclined to believe that the orbit of Mars is oval, nor was it until after a wearisome study that he detected the grand truth, its elliptical form. An idea of the incorruptibility of the celestial objects had led to the adoption of the Aristotelian doctrine of the perfection of circular motions, and to the belief that there were none but circular motions in the heavens. He bitterly complains of this as having been a fatal "thief of his time." His philosophical daring is illustrated in his breaking through this time-honored tradition.

In some most important particulars Kepler anticipated Newton. He was the first to give clear ideas respecting gravity. He says every particle of matter will rest until it is disturbed by some other particle—that the earth attracts a stone more than the stone attracts the earth, and that bodies move to each other in proportion to their masses; that the earth would ascend to the moon one-fifty-fourth of the distance, and the moon would move toward the earth the other fifty-three. He affirms that the moon's attraction causes the tides, and that the planets must impress irregularities on the moon's motions.

The progress of astronomy is obviously divisible into three periods:

1. The period of observation of the apparent motions of the heavenly bodies.

2. The period of discovery of their real motions, and particularly of the laws of the planetary revolutions; this was signally illustrated by Copernicus and Kepler.

3. The period of the ascertainment of the causes of those laws. It was the epoch of Newton.

The passage of the second into the third period depended on the development of the Dynamical branch of mechanics, which had been in a stagnant condition from the time of Archimedes or the Alexandrian School.

In Christian Europe there had not been a cultivator of mechanical philosophy until Leonardo da Vinci, who was born A. D. 1452. To him, and not to Lord Bacon, must be attributed the renaissance of science. Bacon was not only ignorant of mathematics, but depreciated its application to physical inquiries. He contemptuously rejected the Copernican system, alleging absurd objections to it. While Galileo was on the brink of his great telescopic discoveries, Bacon was publishing doubts as to the utility of instruments in scientific investigations. To ascribe the inductive method to him is to ignore history. His fanciful philosophical suggestions have never been of the slightest practical use. No one has ever thought of employing them. Except among English readers, his name is almost unknown.

To Da Vinci I shall have occasion to allude more particularly on a subsequent page. Of his works still remaining in manuscript, two volumes are at Milan, and one in Paris, carried there by Napoleon.

After an interval of about seventy years, Da Vinci was followed by the Dutch engineer, Stevinus, whose work on the principles of equilibrium was published in 1586. Six years afterward appeared Galileo's treatise on mechanics.

To this great Italian is due the establishment of the three fundamental laws of dynamics, known as the Laws of Motion.

The consequences of the establishment of these laws were very important.

It had been supposed that continuous movements, such, for instance, as those of the celestial bodies, could only be maintained by a perpetual consumption and perpetual application of force, but the first of Galileo's laws declared that every body will persevere in its state of rest, or of uniform motion in a right line, until it is compelled to change that state by disturbing forces. A clear perception of this fundamental principle is essential to a comprehension of the elementary facts of physical astronomy. Since all the motions that we witness taking place on the surface of the earth soon come to an end, we are led to infer that rest is the natural condition of things. We have made, then, a very great advance when we have become satisfied that a body is equally indifferent to rest as to motion, and that it equally perseveres in either state until disturbing forces are applied. Such disturbing forces in the case of common movements are friction and the resistance of the air. When no such resistances exist, movement must be per-

petual, as is the case with the heavenly bodies, which are moving in a void.

Forces, no matter what their difference of magnitude may be, will exert their full influence conjointly, each as though the other did not exist. Thus, when a ball is suffered to drop from the mouth of a cannon, it falls to the ground in a certain interval of time through the influence of gravity upon it. If, then, it be fired from the cannon, though now it may be projected some thousands of feet in a second, the effect of gravity upon it will be precisely the same as before. In the intermingling of forces there is no deterioration; each produces its own specific effect.

In the latter half of the seventeenth century, through the works of Borelli, Hooke, and Huyghens, it had become plain that circular motions could be accounted for by the laws of Galileo. Borelli, treating of the motions of Jupiter's satellites, shows how a circular movement may arise under the influence of a central force. Hooke exhibited the inflection of a direct motion into a circular by a supervening central attraction.

The year 1687 presents, not only an epoch in European science, but also in the intellectual development of man. It is marked by the publication of the "Principia" of Newton, an incomparable, an immortal work.

On the principle that all bodies attract each other with forces directly as their masses, and inversely as the squares of their distances, Newton showed

that all the movements of the celestial bodies may be accounted for, and that Kepler's laws might all have been predicted—the elliptic motions—the described areas—the relation of the times and distances. As we have seen, Newton's contemporaries had perceived how circular motions could be explained; that was a special case, but Newton furnished the solution of the general problem, containing all special cases of motion in circles, ellipses, parabolas, hyperbolas—that is, in all the conic sections.

The Alexandrian mathematicians had shown that the direction of movement of falling bodies is toward the centre of the earth. Newton proved that this must necessarily be the case, the general effect of the attraction of all the particles of a sphere being the same as if they were all concentrated in its centre.

To this central force, thus determining the fall of bodies, the designation of gravity was given. Up to this time, no one, except Kepler, had considered how far its influence reached. It seemed to Newton possible that it might extend as far as the moon, and be the force that deflects her from a rectilinear path, and makes her revolve in her orbit round the earth. It was easy to compute, on the principle of the law of inverse squares, whether the earth's attraction was sufficient to produce the observed effect. Employing the measures of the size of the earth accessible at the time, Newton found that the moon's deflection was only thirteen feet in a minute; Whereas, if his hypothesis of gravitation were true,

it should be fifteen feet. But in 1669 Picard, as we have seen, executed the measurement of a degree more carefully than had previously been done; this changed the estimate of the magnitude of the earth, and, therefore, of the distance of the moon; and, Newton's attention having been directed to it by some discussions that took place at the Royal Society in 1679, he obtained Picard's results, went home, took out his old papers, and resumed his calculations. As they drew to a close, he became so much agitated that he was obliged to desire a friend to finish them. The expected coincidence was established. It was proved that the moon is retained in her orbit and made to revolve round the earth by the force of terrestrial gravity. The genii of Kepler had given place to the vortices of Descartes, and these in their turn to the central force of Newton.

In like manner the earth, and each of the planets, are made to move in an elliptic orbit round the sun by his attractive force, and perturbations arise by reason of the disturbing action of the planetary masses on one another. Knowing the masses and the distances, these disturbances may be computed. Later astronomers have even succeeded with the inverse problem, that is, knowing the perturbations or disturbances, to find the place and the mass of the disturbing body. Thus, from the deviations of Uranus from his theoretical position, the discovery of Neptune was accomplished.

Newton's merit consisted in this, that he applied the laws of dynamics to the movements of the ce-

lestial bodies, and insisted that scientific theories must be substantiated by the agreement of observations with calculations.

When Kepler announced his three laws, they were received with condemnation by the spiritual authorities, not because of any error they were supposed to present or to contain, but partly because they gave support to the Copernican system, and partly because it was judged inexpedient to admit the prevalence of law of any kind as opposed to providential intervention. The world was regarded as the theatre in which the divine will was daily displayed; it was considered derogatory to the majesty of God that that will should be fettered in any way. The power of the clergy was chiefly manifested in the influence they were alleged to possess in changing his arbitrary determinations. It was thus that they could abate the baleful action of comets, secure fine weather or rain, prevent eclipses, and, arresting the course of Nature, work all manner of miracles; it was thus that the shadow had been made to go back on the dial, and the sun and the moon stopped in mid-career.

In the century preceding the epoch of Newton, a great religious and political revolution had taken place—the Reformation. Though its effect had not been the securing of complete liberty for thought, it had weakened many of the old ecclesiastical bonds. In the reformed countries there was no power to express a condemnation of Newton's works, and among the clergy there was no disposition to give themselves any concern about the mat-

ter. At first the attention of the Protestant was engrossed by the movements of his great enemy the Catholic, and when that source of disquietude ceased, and the inevitable partitions of the Reformation arose, that attention was fastened upon the rival and antagonistic Churches. The Lutheran, the Calvinist, the Episcopalian, the Presbyterian, had something more urgent on hand than Newton's mathematical demonstrations.

So, uncondemned, and indeed unobserved, in this clamor of fighting sects, Newton's grand theory solidly established itself. Its philosophical significance was infinitely more momentous than the dogmas that these persons were quarreling about. It not only accepted the heliocentric theory and the laws discovered by Kepler, but it proved that, no matter what might be the weight of opposing ecclesiastical authority, the sun *must* be the centre of our system, and that Kepler's laws are the result of a mathematical necessity. It is impossible that they should be other than they are.

But what is the meaning of all this? Plainly that the solar system is not interrupted by providential interventions, but is under the government of irreversible law—law that is itself the issue of mathematical necessity.

The telescopic observations of Herschel I. satisfied him that there are very many double stars—double not merely because they are accidentally in the same line of view, but because they are connected physically, revolving round each other. These observations were continued and greatly ex-

tended by Herschel II. The elements of the elliptic orbit of the double star ξ of the Great Bear were determined by Savary, its period being fifty-eight and one-quarter years; those of another, σ Coronæ, were determined by Hind, its period being more than seven hundred and thirty-six years. The orbital movement of these double suns in ellipses compels us to admit that the law of gravitation holds good far beyond the boundaries of the solar system; indeed, as far as the telescope can reach, it demonstrates the reign of law. D'Alembert, in the Introduction to the Encyclopædia, says: "The universe is but a single fact; it is only one great truth."

Shall we, then, conclude that the solar and the starry systems have been called into existence by God, and that he has then imposed upon them by his arbitrary will laws under the control of which it was his pleasure that their movements should be made?

Or are there reasons for believing that these several systems came into existence not by such an arbitrary fiat, but through the operation of law?

The following are some peculiarities displayed by the solar system as enumerated by Laplace. All the planets and their satellites move in ellipses of such small eccentricity that they are nearly circles. All the planets move in the same direction and nearly in the same plane. The movements of the satellites are in the same direction as those of the planets. The movements of rotation of the sun, of the planets, and the satellites, are in the same direction as their orbital motions, and in planes little different.

It is impossible that so many coincidences could be the result of chance! It is not plain that there must have been a common tie among all these bodies, that they are only parts of what must once have been a single mass?

But if we admit that the substance of which the solar system consists once existed in a nebulous condition, and was in rotation, all the above peculiarities follow as necessary mechanical consequences. Nay, more, the formation of planets, the formation of satellites and of asteroids, is accounted for. We see why the outer planets and satellites are larger than the interior ones; why the larger planets rotate rapidly, and the small ones slowly; why of the satellites the outer planets have more, the inner fewer. We are furnished with indications of the time of revolution of the planets in their orbits, and of the satellites in theirs; we perceive the mode of formation of Saturn's rings. We find an explanation of the physical condition of the sun, and the transitions of condition through which the earth and moon have passed, as indicated by their geology.

But two exceptions to the above peculiarities have been noted; they are in the cases of Uranus and Neptune.

The existence of such a nebulous mass once admitted, all the rest follows as a matter of necessity. Is there not, however, a most serious objection in the way? Is not this to exclude Almighty God from the worlds he has made?

First, we must be satisfied whether there is any

solid evidence for admitting the existence of such a nebulous mass.

The nebular hypothesis rests primarily on the telescopic discovery made by Herschel I., that there are scattered here and there in the heavens pale, gleaming patches of light, a few of which are large enough to be visible to the naked eye. Of these, many may be resolved by a sufficient telescopic power into a congeries of stars, but some, such as the great nebula, in Orion, have resisted the best instruments hitherto made.

It was asserted by those who were indisposed to accept the nebular hypothesis, that the non-resolution was due to imperfection in the telescopes used. In these instruments two distinct functions may be observed: their light-gathering power depends on the diameter of their object mirror or lens, their defining power depends on the exquisite correctness of their optical surfaces. Grand instruments may possess the former quality in perfection by reason of their size, but the latter very imperfectly, either through want of original configuration, or distortion arising from flexure through their own weight. But, unless an instrument be perfect in this respect, as well as adequate in the other, it may fail to decompose a nebula into discrete points.

Fortunately, however, other means for the settlement of this question are available. In 1846, it was discovered by the author of this book that the spectrum of an ignited solid is continuous—that is, has neither dark nor bright lines. Fraunhofer had previously made known that the spectrum of ig-

nited gases is discontinuous. Here, then, is the means of determining whether the light emitted by a given nebula comes from an incandescent gas, or from a congeries of ignited solids, stars, or suns. If its spectrum be discontinuous, it is a true nebula or gas; if continuous, a congeries of stars.

In 1864, Mr. Huggins made this examination in the case of a nebula in the constellation Draco. It proved to be gaseous.

Subsequent observations have shown that, of sixty nebulæ examined, nineteen give discontinuous or gaseous spectra—the remainder continuous ones.

It may, therefore, be admitted that physical evidence has at length been obtained, demonstrating the existence of vast masses of matter in a gaseous condition, and at a temperature of incandescence. The hypothesis of Laplace has thus a firm basis. In such a nebular mass, cooling by radiation is a necessary incident, and condensation and rotation the inevitable results. There must be a separation of rings all lying in one plane, a generation of planets and satellites all rotating alike, a central sun and engirdling globes. From a chaotic mass, through the operation of natural laws, an organized system has been produced. An integration of matter into worlds has taken place through a decline of heat.

If such be the cosmogony of the solar system, such the genesis of the planetary worlds, we are constrained to extend our views of the dominion of law, and to recognize its agency in the creation as well as in the conservation of the innumerable orbs that throng the universe.

But again, it may be asked: "Is there not something profoundly impious in this? Are we not excluding Almighty God from the world he has made?"

We have often witnessed the formation of a cloud in a serene sky. A hazy point, barely perceptible—a little wreath of mist—increases in volume, and becomes darker and denser, until it obscures a large portion of the heavens. It throws itself into fantastic shapes, it gathers a glory from the sun, is borne onward by the wind, and, perhaps, as it gradually came, so it gradually disappears, melting away in the untroubled air.

Now, we say that the little vesicles of which this cloud was composed arose from the condensation of water-vapor preëxisting in the atmosphere, through reduction of temperature; we show how they assumed the form they present. We assign optical reasons for the brightness or blackness of the cloud; we explain, on mechanical principles, its drifting before the wind; for its disappearance we account on the principles of chemistry. It never occurs to us to invoke the interposition of the Almighty in the production and fashioning of this fugitive form. We explain all the facts connected with it by physical laws, and perhaps should reverentially hesitate to call into operation the finger of God.

But the universe is nothing more than such a cloud—a cloud of suns and worlds. Supremely grand though it may seem to us, to the Infinite and Eternal Intellect it is no more than a fleeting mist. If there be a multiplicity of worlds in infinite space,

there is also a succession of worlds in infinite time. As one after another cloud replaces cloud in the skies, so this starry system, the universe, is the successor of countless others that have preceded it—the predecessor of countless others that will follow. There is an unceasing metamorphosis, a sequence of events, without beginning or end.

If, on physical principles, we account for minor meteorological incidents, mists and clouds, is it not permissible for us to appeal to the same principle in the origin of world-systems and universes, which are only clouds on a space-scale somewhat larger, mists on a time-scale somewhat less transient? Can any man place the line which bounds the physical on one side, the supernatural on the other? Do not our estimates of the extent and the duration of things depend altogether on our point of view? Were we set in the midst of the great nebula of Orion, how transcendently magnificent the scene! The vast transformations, the condensations of a fiery mist into worlds, might seem worthy of the immediate presence, the supervision of God; here, at our distant station, where millions of miles are inappreciable to our eyes, and suns seem no bigger than motes in the air, that nebula is more insignificant than the faintest cloud. Galileo, in his description of the constellation of Orion, did not think it worth while so much as to mention it. The most rigorous theologian of those days would have seen nothing to blame in imputing its origin to secondary causes, nothing irreligious in failing to invoke the arbitrary interference of God in its meta-

morphoses. If such be the conclusion to which we come respecting it, what would be the conclusion to which an Intelligence seated in it might come respecting us? It occupies an extent of space millions of times greater than that of our solar system; we are invisible from it, and therefore absolutely insignificant. Would such an Intelligence think it necessary to require for our origin and maintenance the immediate intervention of God?

From the solar system let us descend to what is still more insignificant—a little portion of it; let us descend to our own earth. In the lapse of time it has experienced great changes. Have these been due to incessant divine interventions, or to the continuous operation of unfailing law? The aspect of Nature perpetually varies under our eyes, still more grandly and strikingly has it altered in geological times. But the laws guiding those changes never exhibit the slightest variation. In the midst of immense vicissitudes they are immutable. The present order of things is only a link in a vast connected chain reaching back to an incalculable past, and forward to an infinite future.

There is evidence, geological and astronomical, that the temperature of the earth and her satellite was in the remote past very much higher than it is now. A decline so slow as to be imperceptible at short intervals, but manifest enough in the course of many ages, has occurred. The heat has been lost by radiation into space.

The cooling of a mass of any kind, no matter

whether large or small, is not discontinuous; it does not go on by fits and starts; it takes place under the operation of a mathematical law, though for such mighty changes as are here contemplated neither the formula of Newton, nor that of Dulong and Petit, may apply. It signifies nothing that periods of partial decline, glacial periods, or others of temporary elevation, have been intercalated; it signifies nothing whether these variations may have arisen from topographical variations, as those of level, or from periodicities in the radiation of the sun. A periodical sun would act as a mere perturbation in the gradual decline of heat. The perturbations of the planetary motions are a confirmation, not a disproof, of gravity.

Now, such a decline of temperature must have been attended by innumerable changes of a physical character in our globe. Her dimensions must have diminished through contraction, the length of her day must have lessened, her surface must have collapsed, and fractures taken place along the lines of least resistance; the density of the sea must have increased, its volume must have become less; the constitution of the atmosphere must have varied, especially in the amount of water-vapor and carbonic acid that it contained; the barometric pressure must have declined.

These changes, and very many more that might be mentioned, must have taken place not in a discontinuous but in an orderly manner, since the master-fact, the decline of heat, that was causing them, was itself following a mathematical law.

But not alone did lifeless Nature submit to these inevitable mutations; living Nature was also simultaneously affected.

An organic form of any kind, vegetable or animal, will remain unchanged only so long as the environment in which it is placed remains unchanged. Should an alteration in the environment occur, the organism will either be modified or destroyed.

Destruction is more likely to happen as the change in the environment is more sudden; modification or transformation is more possible as that change is more gradual.

Since it is demonstrably certain that lifeless Nature has in the lapse of ages undergone vast modifications; since the crust of the earth, and the sea, and the atmosphere, are no longer such as they once were; since the distribution of the land and the ocean and all manner of physical conditions have varied; since there have been such grand changes in the environment of living things on the surface of our planet—it necessarily follows that organic Nature must have passed through destructions and transformations in correspondence thereto.

That such extinctions, such modifications, have taken place, how copious, how convincing, is the evidence!

Here, again, we must observe that, since the disturbing agency was itself following a mathematical law, these its results must be considered as following that law too.

Such considerations, then, plainly force upon us the conclusion that the organic progress of the

world has been guided by the operation of immutable law—not determined by discontinuous, disconnected, arbitrary interventions of God. They incline us to view favorably the idea of transmutations of one form into another, rather than that of sudden creations.

Creation implies an abrupt appearance, transformation a gradual change.

In this manner is presented to our contemplation the great theory of Evolution. Every organic being has a place in a chain of events. It is not an isolated, a capricious fact, but an unavoidable phenomenon. It has its place in that vast, orderly concourse which has successively risen in the past, has introduced the present, and is preparing the way for a predestined future. From point to point in this vast progression there has been a gradual, a definite, a continuous unfolding, a resistless order of evolution. But in the midst of these mighty changes stand forth immutable the laws that are dominating over all.

If we examine the introduction of any type of life in the animal series, we find that it is in accordance with transformation, not with creation. Its beginning is under an imperfect form in the midst of other forms, of which the time is nearly complete, and which are passing into extinction. By degrees, one species after another in succession more and more perfect arises, until, after many ages, a culmination is reached. From that there is, in like manner, a long, a gradual decline.

Thus, though the mammal type of life is the

characteristic of the Tertiary and post-Tertiary periods, it does not suddenly make its appearance without premonition in those periods. Far back, in the Secondary, we find it under imperfect forms, struggling, as it were, to make good a foothold. At length it gains a predominance under higher and better models.

So, too, of reptiles, the characteristic type of life of the Secondary period. As we see in a dissolving view, out of the fading outlines of a scene that is passing away, the dim form of a new one emerging, which gradually gains strength, reaches its culmination, and then melts away in some other that is displacing it, so reptile-life doubtfully appears, reaches its culmination, and gradually declines. In all this there is nothing abrupt; the changes shade into each other by insensible degrees.

How could it be otherwise? The hot-blooded animals could not exist in an atmosphere so laden with carbonic acid as was that of the primitive times. But the removal of that noxious ingredient from the air by the leaves of plants under the influence of sunlight, the enveloping of its carbon in the earth under the form of coal, the disengagement of its oxygen, permitted their life. As the atmosphere was thus modified, the sea was involved in the change; it surrendered a large part of its carbonic acid, and the limestone hitherto held in solution by it was deposited in the solid form. For every equivalent of carbon buried in the earth, there was an equivalent of carbonate of lime separated from the sea—not necessarily in an amorphous

condition, most frequently under an organic form. The sunshine kept up its work day by day, but there were demanded myriads of days for the work to be completed. It was a slow passage from a noxious to a purified atmosphere, and an equally slow passage from a cold-blooded to a hot-blooded type of life. But the physical changes were taking place under the control of law, and the organic transformations were not sudden or arbitrary providential acts. They were the immediate, the inevitable consequences of the physical changes, and therefore, like them, the necessary issue of law.

Is the world, then, governed by law or by providential interventions, abruptly breaking the proper sequence of events?

To complete our view of this question, we turn finally to what, in one sense, is the most insignificant, in another the most important, case that can be considered. Do human societies, in their historic career, exhibit the marks of a predetermined progress in an unavoidable track? Is there any evidence that the life of nations is under the control of immutable law?

May we conclude that, in society, as in the individual man, parts never spring from nothing, but are evolved or developed from parts that are already in existence?

If any one should object to or deride the doctrine of the evolution or successive development of the animated forms which constitute that unbroken organic chain reaching from the beginning of life

on the globe to the present times, let him reflect that he has himself passed through modifications the counterpart of those he disputes. For nine months his type of life was aquatic, and during that time he assumed, in succession, many distinct but correlated forms. At birth his type of life became aërial; he began respiring the atmospheric air; new elements of food were supplied to him; the mode of his nutrition changed; but as yet he could see nothing, hear nothing, notice nothing. By degrees conscious existence was assumed; he became aware that there is an external world. In due time organs adapted to another change of food, the teeth, appeared, and a change of food ensued. He then passed through the stages of childhood and youth, his bodily form developing, and with it his intellectual powers. At about fifteen years, in consequence of the evolution which special parts of his system had attained, his moral character changed. New ideas, new passions, influenced him. And that that was the cause, and this the effect, is demonstrated when, by the skill of the surgeon, those parts have been interfered with. Nor does the development, the metamorphosis, end here; it requires many years for the body to reach its full perfection, many years for the mind. A culmination is at length reached, and then there is a decline. I need not picture its mournful incidents—the corporeal, the intellectual enfeeblement. Perhaps there is little exaggeration in saying that in less than a century every human being on the face of the globe, if not cut off in an

untimely manner, has passed through all these changes.

Is there for each of us a providential intervention as we thus pass from stage to stage of life? or shall we not rather believe that the countless myriads of human beings who have peopled the earth have been under the guidance of an unchanging, a universal law?

But individuals are the elementary constituents of communities—nations. They maintain therein a relation like that which the particles of the body maintain to the body itself. These, introduced into it, commence and complete their function; they die, and are dismissed.

Like the individual, the nation comes into existence without its own knowledge, and dies without its own consent, often against its own will. National life differs in no particular from individual, except in this, that it is spread over a longer span, but no nation can escape its inevitable term. Each, if its history be well considered, shows its time of infancy, its time of youth, its time of maturity, its time of decline, if its phases of life be completed.

In the phases of existence of all, so far as those phases are completed, there are common characteristics, and, as like accordances in individuals point out that all are living under a reign of law, we are justified in inferring that the course of nations, and indeed the progress of humanity, does not take place in a chance or random way, that supernatural

interventions never break the chain of historic acts, that every historic event has its warrant in some preceding event, and gives warrant to others that are to follow.

But this conclusion is the essential principle of Stoicism—that Grecian philosophical system which, as I have already said, offered a support in their hour of trial and an unwavering guide in the vicissitudes of life, not only to many illustrious Greeks, but also to some of the great philosophers, statesmen, generals, and emperors of Rome; a system which excluded chance from every thing, and asserted the direction of all events by irresistible necessity, to the promotion of perfect good; a system of earnestness, sternness, austerity, virtue—a protest in favor of the common-sense of mankind. And perhaps we shall not dissent from the remark of Montesquieu, who affirms that the destruction of the Stoics was a great calamity to the human race; for they alone made great citizens, great men.

To the principle of government by law, Latin Christianity, in its papal form, is in absolute contradiction. The history of this branch of the Christian Church is almost a diary of miracles and supernatural interventions. These show that the supplications of holy men have often arrested the course of Nature—if, indeed, there be any such course; that images and pictures have worked wonders; that bones, hairs, and other sacred relics, have wrought miracles. The criterion or proof of the authenticity of many of these objects is, not an unchallengeable

record of their origin and history, but an exhibition of their miracle-working powers.

Is not that a strange logic which finds proof of an asserted fact in an inexplicable illustration of something else?

Even in the darkest ages intelligent Christian men must have had misgivings as to these alleged providential or miraculous interventions. There is a solemn grandeur in the orderly progress of Nature which profoundly impresses us; and such is the character of continuity in the events of our individual life that we instinctively doubt the occurrence of the supernatural in that of our neighbor. The intelligent man knows well that, for his personal behoof, the course of Nature has never been checked; for him no miracle has ever been worked; he attributes justly every event of his life to some antecedent event; this he looks upon as the cause, that as the consequence. When it is affirmed that, in his neighbor's behalf, such grand interventions have been vouchsafed, he cannot do otherwise than believe that his neighbor is either deceived, or practising deception.

As might, then, have been anticipated, the Catholic doctrine of miraculous intervention received a rude shock at the time of the Reformation, when predestination and election were upheld by some of the greatest theologians, and accepted by some of the greatest Protestant Churches. With stoical austerity Calvin declares: "We were elected from eternity, before the foundation of the world, from

no merit of our own, but according to the purpose of the divine pleasure." In affirming this, Calvin was resting on the belief that God has from all eternity decreed whatever comes to pass. Thus, after the lapse of many ages, were again emerging into prominence the ideas of the Basilidians and Valentinians, Christian sects of the second century, whose Gnostical views led to the engraftment of the great doctrine of the Trinity upon Christianity. They asserted that all the actions of men are necessary, that even faith is a natural gift, to which men are forcibly determined, and must therefore be saved, though their lives be ever so irregular. From the Supreme God all things proceeded. Thus, also, came into prominence the views which were developed by Augustine in his work, "De dono perseverantiæ." These were: that God, by his arbitrary will, has selected certain persons without respect to foreseen faith or good works, and has infallibly ordained to bestow upon them eternal happiness; other persons, in like manner, he has condemned to eternal reprobation. The Sublapsarians believed that "God permitted the fall of Adam;" the Supralapsarians that "he predestinated it, with all its pernicious consequences, from all eternity, and that our first parents had no liberty from the beginning." In this, these sectarians disregarded the remark of St. Augustine: "Nefas est dicere Deum aliquid nisi bonun predestinare."

Is it true, then, that "predestination to eternal happiness is the everlasting purpose of God, whereby, before the foundations of the world were laid,

he hath constantly decreed by his council, secret to us, to deliver from curse and damnation those whom he hath chosen out of mankind?" Is it true that of the human family there are some who, in view of no fault of their own, Almighty God has condemned to unending torture, eternal misery?

In 1595 the Lambeth Articles asserted that "God from eternity hath predestinated certain men unto life; certain he hath reprobated." In 1618 the Synod of Dort decided in favor of this view. It condemned the remonstrants against it, and treated them with such severity, that many of them had to flee to foreign countries. Even in the Church of England, as is manifested by its seventeenth Article of Faith, these doctrines have found favor.

Probably there was no point which brought down from the Catholics on the Protestants severer condemnation than this, their partial acceptance of the government of the world by law. In all Reformed Europe miracles ceased. But, with the cessation of shrine-cure, relic-cure, great pecuniary profits ended. Indeed, as is well known, it was the sale of indulgences that provoked the Reformation—indulgences which are essentially a permit from God for the practice of sin, conditioned on the payment of a certain sum of money to the priest.

Philosophically, the Reformation implied a protest against the Catholic doctrine of incessant divine intervention in human affairs, invoked by sacerdotal agency; but this protest was far from being fully made by all the Reforming Churches. The evidence in behalf of government by law, which has

of late years been offered by science, is received by many of them with suspicion, perhaps with dislike; sentiments which, however, must eventually give way before the hourly-increasing weight of evidence.

Shall we not, then, conclude with Cicero, who, quoted by Lactantius, says: "One eternal and immutable law embraces all things and all times"?


THE CAUSE OF
LABOUR IS THE
HOPE OF THE WORLD
Proclaim Liberty throughout
all the land unto All the
Inhabitants thereof.